https://www.acoe2025.com/

A-COE 2025

The 17th Asian Conference on Organic Electronics

2025. 11.12 [Wed] – 11.15 [Sat]

Pukyong National University, Busan, Korea

Organized by

고려대학교 기초과학연구원 Korea University The Institute of Basic Science

경상국립대학교 G-LAMP

분자제어연구소 Research Institute of Molecular Alchemy

한국고분자학회 The Polymer Society of Korea

PKNURISE

에너지융복합소재연구소(국립부경대학교 중점연구소) Center for Energy Conversion/Storage Utilization System

Supported by

한국관광공사 KOREA TOURISM ORGANIZATION

부산관광공사 BUSAN TOURISM ORGANIZATION

다중접합 광전소자 AI 플랫폼개발 연구센터

BK21 POSTECH 화학공학혁신리더 교육연구단

HY POWER 한양대학교 화학공학과 BK21 탄소중립 첨단소재 교육연구단

WILEY VCH

<table>
<tr><th>Date/Time</th><th>11.12 (Wed)</th><th>11.13 (Thu)</th><th>11.14 (Fri)</th><th>11.15 (Sat)</th></tr>
<tr><td rowspan="2">08:00</td><td rowspan="12"></td><td>Registration</td><td>Registration</td><td>Registration</td></tr>
<tr><td>Opening ceremony
(08:30–08:45)</td><td>Plenary Lecture 03
(08:30–09:10)</td><td>Plenary Lecture 05
(08:30–09:10)</td></tr>
<tr><td rowspan="2">09:00</td><td>Plenary Lecture 01
(08:45–09:25)</td><td>Plenary Lecture 04
(09:10–09:50)</td><td rowspan="2">Invited Lectures
(09:10–10:00)</td></tr>
<tr><td>Plenary Lecture 02
(09:25–10:05)</td><td>Coffee Break
(09:50–10:20)</td></tr>
<tr><td rowspan="2">10:00</td><td>Coffee Break
(10:05–10:35)</td><td rowspan="3">Invited Lectures
(10:20–11:35)</td><td>Coffee Break
(10:00–10:30)</td></tr>
<tr><td rowspan="2">Invited Lectures
(10:35–11:50)</td><td rowspan="2">Invited Lectures
(10:30–11:45)</td></tr>
<tr><td rowspan="2">11:00</td><td rowspan="3">Poster Session 2
+ Lunch
(11:35–13:45)</td></tr>
<tr><td rowspan="2">12:00</td><td rowspan="2">Poster Session 1
+ Lunch
(11:50–14:00)</td><td>Closing ceremony
+ Poster award
(11:45–12:15)</td></tr>
<tr><td rowspan="2">13:00</td><td rowspan="3"></td></tr>
<tr><td rowspan="2">14:00</td><td rowspan="2">Invited Lectures
(13:45–15:25)</td></tr>
<tr><td rowspan="2">Invited Lectures
(14:00–15:40)</td></tr>
<tr><td rowspan="2">15:00</td><td>Coffee break
(15:40–16:10)</td><td>Coffee break
(15:25–15:55)</td></tr>
<tr><td rowspan="2">16:00</td><td rowspan="2">Registration</td><td rowspan="2">Invited Lectures
(16:10–17:50)</td><td rowspan="2">Invited Lectures
(15:55–18:00)</td></tr>
<tr><td rowspan="2">17:00</td></tr>
<tr><td rowspan="2">18:00</td><td rowspan="3">Welcome Reception
(18:00–)</td><td rowspan="3"></td><td></td></tr>
<tr><td rowspan="2">19:00</td><td rowspan="2">Banquet
(18:30–)</td></tr>
</table>

	11.13 (Thu)	
08:00–08:30	Registration	
08:30–08:45	**Opening ceremony (15)**	
08:45–09:25	Chair: Tae-Woo Lee (Seoul National University) **[PL01] Unveiling the Fundamentals of OLEDs: Mechanisms of Emission and Charge Transport** Hironori Kaji (Kyoto University)	
09:25–10:05	Chair: Jungyong Lee (Korea Advanced Institute of Science and Technology (KAIST)) **[PL02] Next-Generation Imaging and Energy Conversion with Organic Upconversion, UV Detectors, and Perovskite Electronics** Shun-Wei Liu (Ming Chi University of Technology)	
10:05–10:35	Coffee break (30)	
	Session 1	Session 2
Chair	Junghwan Kim (Pukyong National University)	Chih-Wei Chu (Academia Sinica)
10:35–11:00	**[IV01-1] Endothermic singlet fission process in harvesting the high-level excitation energy for tetracene-based photodiodes** Tzung-Fang Guo (National Cheng Kung University)	**[IV02-1] Application of Heavy Chalcogens in Organic Light-Emitting Materials** Shijian Su (South China University of Technology)
11:00–11:25	**[IV01-2] Nanocrystalline Perovskite Emitter for Future Displays** Tae-Woo Lee (Seoul National University)	**[IV02-2] A post-processing approach to unlock mixed conduction in organic semiconductors** Christine Luscombe (Okinawa Institute of Science and Technology (OIST))
11:25–11:50	**[IV01-3] Surface-Engineered Perovskite Nanocrystals for Advanced Optoelectronic Applications** Takayuki Chiba (Yamagata University)	**[IV02-3] 3,6-Bis(methylthio)-9H-carbazole Based Self-Assembled Monolayer for Highly D27Efficient and Stable Inverted Perovskite Solar Cells** BongSoo Kim (Ulsan National Institute of Science and Technology (UNIST))
11:50–14:00	**Poster session 1** + Lunch (130)	
Chair	Tzung-Fang Guo (National Cheng Kung University)	BongSoo Kim (Ulsan National Institute of Science and Technology (UNIST))
14:00–14:25	**[IV01-4] Scalable fabrication of perovskite solar cells via magnetron sputtering** Dechun Zou (Peking University)	**[IV02-4] Charge separation and recombination interfaces in organic solar cells** James Robert Durrant (Imperial College London)
14:25–14:50	**[IV01-5] Ultrafast Refractive Index Spectroscopy for Probing Photoinduced Processes in Optoelectronic Material** Kai Chen (Victoria University of Wellington)	**[IV02-5] Material Design for Synaptic Transistors: From Conjugated Polymers to Two-Dimensional Perovskites** Chu-Chen Chueh (National Taiwan University)
14:50–15:15	**[IV01-6] Organic/Hybrid Thermoelectric Materials and Devices** Cheng-Liang Liu (National Taiwan University)	**[IV02-6] Controlling light-matter interactions for efficient organic and hybrid optoelectronics** Shaocong Hou (Wuhan University)
15:15–15:40	**[IV01-7] AI-Assisted Study of Perovskite Solar Cells** Lixin Xiao (Peking University)	**[IV02-7] Tetrabenzoporphyrins for High-Performance Single-Crystal Organic Field-Effect Transistors** Hiroko Yamada (Kyoto University)
15:40–16:10	Coffee break (30)	
Chair	Cheng-Liang Liu (National Taiwan University)	Chu-Chen Chueh (National Taiwan University)
16:10–16:35	**[IV01-8] Engineering Stable Multi-Resonance Fluorescence Emitters for Durable Blue Organic Light Emitting Diodes** Jang Hyuk Kwon (Kyung Hee University)	**[IV02-8] Understanding Polaron Formation and Transport in Organic Electrochemical Devices** Ji-Seon Kim (University of Oxford)
16:35–17:00	**[IV01-9] Photoactive Material Design for Intrinsically-Stretchable Polymer Solar Cells** Bumjoon Kim (Korea Advanced Institute of Science and Technology (KAIST))	**[IV02-9] A Semiconductor-Sensitized Thermal Cell Inspired by Dye-Sensitized Solar Cell** Sachiko Matsushita (Institute of Science Tokyo)
17:00–17:25	**[IV01-10] Squaraine aggregates and films: from modeling to photodetectors** Anna Painelli (Parma University)	**[IV02-10] Atomic Layer Deposition-Free Tin Oxide as an Electron Transport Layer for Wide-Bandgap Perovskite Solar Cells and Si/Perovskite Tandem Solar Cells** Chih-Wei Chu (Academia Sinica)
17:25–17:50	**[IV01-11] From Ensemble to Individual: Single Perovskite Quantum Dots for Quantum Emission Applications** Hao-Wu Lin (National Tsing Hua University)	**[IV02-11] Influences of spontaneous orientation polarization on device performance in organic light-emitting diodes** Yutaka Noguchi (Meiji University)

	11.14 (Fri)	
08:00–08:30	Registration	
08:30–09:10	Chair: Jong H. Kim (Ajou University) **[PL03] Dual-Mode Narrowband Near-Infrared Organic Photodetectors** Furong Zhu (Hong Kong Baptist University)	
09:10–09:50	Chair: Han Young Woo (Korea University) **[PL04] Evolution of Organic Semiconductor Materials: From Molecular Design to Device Applications** Dong Hoon Choi (Korea University)	
09:50–10:20	Coffee break (30)	
	Session 1	Session 2
Chair	Hyojung Cha (Kyungpook National University)	Myung-Han Yoon (Gwangju Institute of Science and Technology (GIST))
10:20–10:45	**[IV03-1] Broadband Multiple-Plate Continuum Light Source for Ultrafast Transient Absorption Studies of Organic Upconversion Devices** Bo-Han Chen (National Tsing Hua University)	**[IV04-1] A Metal-Free Phthalocyanine Additive for Defect Passivation and Processing Tolerance in High-Efficiency Perovskite Solar Cells** Chih-Hsin Chen (Tamkang University)
10:45–11:10	**[IV03-2] Multiresonance-Donor-Multiresonance Emitter for Efficient Narrowband Blue OLEDs** Jianxin Tang (Macau University of Science and Technology)	**[IV04-2] Detecting Nitrogen Environmental Pollution using Amine/Sulfur Gas Detection** Hsiao-Wen Zan (National Yang Ming Chiao Tung University)
11:10–11:35	**[IV03-3] Inverted Region of Reverse Intersystem Crossing in Inverted Singlet-Triplet Materials** Naoya Aizawa (Osaka University)	**[IV04-3] Mitigating Voltage Loss through Interfacial Engineering for High-Performance Perovskite/Organic Tandem Solar Cells** Jin Young Kim (Ulsan National Institute of Science and Technology (UNIST))
11:35–13:45	Poster session 2 + Lunch (130)	
Chair	Naoya Aizawa (Osaka University)	Chih-Hsin Chen (Tamkang University)
13:45–14:10	**[IV03-4] Organic Free-form Electronics for Wearable Displays and Sensors** Seunghyup Yoo (Korea Advanced Institute of Science and Technology (KAIST))	**[IV04-4] Dibenzofuran-Based Charge Transport Materials for High-Efficiency and Long-Lifetime OLEDs and QLEDs** Youngu Lee (Daegu Gyeongbuk Institute of Science & Technology (DGIST))
14:10–14:35	**[IV03-5] Sustainable Silicone Lithography of Organic Semiconductors for Human-interactive RGB OLED Microdisplay** Do Hwan Kim (Hanyang University)	**[IV04-5] Organic Photodiode : Beyond RGB Sensing** Dae Sung Chung (Pohang University of Science and Technology (POSTECH))
14:35–15:00	**[IV03-6] Multi-functional ambipolar organic interlayer for high-performance perovskite solar cells** Jong H. Kim (Ajou University)	**[IV04-6] Development of high-performance Sn based perovskite transistors** Yong-Young Noh (Pohang University of Science and Technology (POSTECH))
15:00–15:25	**[IV03-7] Diazafluoren(on)es and Diazafluorenylidenes for Organic Optoelectronic Devices and Smart Materials** M.S. Kazantsev (N.N. Vorozhtsov Novosibirsk Institute of Organic Chemistry)	**[IV04-7] Organic Floating-Gate Transistors for Optoelectronic Nonvolatile Memory and Artificial Synapse Applications** Takashi Nagase (Osaka Metropolitan University)
15:25–15:55	Coffee break (30)	
Chair	Seunghyup Yoo (KAIST)	Seunghyeon Kim (DGIST)
15:55–16:20	**[IV03-8] Functional-Group-Oriented Anti-Solvent Additives for Photostable Perovskite Solar Cells** Jongchul Lim (Chungnam National University)	**[IV04-8] Crystallized PEDOT:PSS-Based Unconventional Energy Conversion and Storage Systems** Myung-Han Yoon (Gwangju Institute of Science and Technology (GIST))
16:20–16:45	**[IV03-9] Toward Scalable and Deployable Organic Ammonia Sensors: From Device Innovation to Real-World Applications** Li-Yin Chen (National Yang Ming Chiao Tung University)	**[IV04-9] Design and study of novel organic mixed ionic-electronic conductors** Micaela Matta (Kings College London)
16:45–17:10	**[IV03-10] Molecular dynamics simulation of organic materials for mechanical, chemical and spectroscopic predictions** Toshihiro Shimada (Hokkaido University)	**[IV04-10] Molecular Dipole Engineering of Polymer Semiconductors for Stretchable and High-Performance Electronics** Chien-Chung Shih (National Yunlin University of Science and Technology)
17:10–17:35	**[IV03-11] Study on Charge Carrier Dynamics of Organic Photovoltaics and Photocatalysts** Hyojung Cha (Kyungpook National University)	**[IV04-11] Practical Applications of Molecular Simulations in Perovskite Solar Cells** Tae Kyung Lee (Gyeongsang National University)
17:35–18:00	**[IV03-12] Introduction to Angewandte Chemie – Opening the Editor's Black Box** Haeryung Lee (Angewandte Chemie (Wiley), Deputy Editor)	

	11.15 (Sat)	
08:00–08:30	Registration	
08:30–09:10	Chair: Han Young Woo (Korea University) **[PL05] Engineering Disorder and Carrier–Dopant Interactions in Doped Conjugated Polymers for Enhanced Charge Transport** Kilwon Cho (Pohang University of Science and Technology (POSTECH))	
	Session 1	Session 2
Chair	Jaewon Chang (Pukyong National University)	Toshinori Matsushima (Kyushu University)
09:10–09:35	[IV05–1] Photoluminescence Enhancement up to 350 K of Monophase α–$FAPbI_3$ Quantum Dots Synthesized via Tailored Hot Injection Myeongkee Park (Pukyong National University)	[IV06–1] Solution–processed OLEDs with high performance Guohua Xie (Xiamen University)
09:35–10:00	[IV05–2] Naphthalenediimide (NDI)– Based N–type Conjugated Polymers as Organic Cathodes for Lithium–ion Batteries Wonho Lee (Kumoh National Institute of Technology)	[IV06–2] Dynamic Exciton Model: A Comprehensive ΔEST Estimation Method for TADF Materials Youichi Tsuchiya (Kyushu University)
10:00–10:30	Coffee break (30)	
10:30–10:55	[IV05–3] Fabrication of Blue–Emissive Perovskite Nanocrystals by Size Control and Post–Treatment of Short Ligand Chang–Lyoul Lee (Gwangju Institute of Science and Technology (GIST))	[IV06–3] Synergistic Additive and Interface Engineering for High–Efficiency and Stable Inverted Perovskite Solar Cells Sung Heum Park (Pukyong National University)
10:55–11:20	[IV05–4] Next Generation NIR/SWIR Photodetectors using Organic Semiconductors Seo–Jin Ko (Daegu Gyeongbuk Institute of Science & Technology (DGIST))	[IV06–4] Toward High–Performance Perovskite Solar Cells Based on Organic Materials Chemistry Toshinori Matsushima (Kyushu University)
11:20–11:45	[IV05–5] Enhancing Photovoltage and Stability in Hybrid Sn–Pb Perovskites via Integrated Interface and Growth Control Chieh–Ting Lin (National Chung Hsing University)	[IV06–5] Tailored Electrical Doping in Perovskite Electronics Keehoon Kang (Seoul National University)
11:45–12:15	**Closing ceremony** + Poster award (30)	

Organized by

고려대학교 기초과학연구원 Korea University The Institute of Basic Science

경상국립대학교 G-LAMP

분자제어연구소 Research Institute of Molecular Alchemy

PKNU RISE 국립부경대학교 라이즈사업단

cecs 에너지융복합소재연구소(국립부경대학교 중점연구소) Center for Energy Conversion/Storage Utilization System

한국고분자학회 The Polymer Society of Korea

Sponsored by

FOUR BK21 POSTECH Education Program for Innovative Chemical Engineering Leaders 화학공학혁신리더 교육연구단

AI 다중접합 광전소자 AI 플랫폼개발 연구센터

HY POWER 한양대학교 화학공학과 BK21 탄소중립 첨단소재 교육연구단

WILEY VCH

한국관광공사 KOREA TOURISM ORGANIZATION

bto 부산관광공사 BUSAN TOURISM ORGANIZATION

Poster session 1 / 11.13 (Thu)			
No.	Title	Presenter	Affilation
01-01	Two-Stage Polymerization Integrates Donor Optimization for Efficient Visible-Light Photocatalytic H_2 Generation)	Sanghyeok An	Pohang University of Science and Technology (POSTECH)
01-02	Ligand-Polymer Crosslinked Architectures Enabling Robust PbS Quantum Dot Photodetectors in the SWIR Region)	Kyobin Park	Pohang University of Science and Technology (POSTECH)
01-03	Molecular Structure Design of Polymer-based Organic Cathodes for Enhanced Capacity and Durable High-temperature Stability	Soyoung Kim	Kumho National Institute of Technology
01-04	Shortwave Infrared Organic Photodiodes Achieving High Performance via Polaron Absorption in Doped Polymers	Sangjun Lee	Pohang University of Science and Technology (POSTECH)
01-05	Enhancing Thermal Stability of Organic Solar Cells via Active Layer Crosslinking with Azide-Functionalized Additives	Yejin Lee	Kumho National Institute of Technology
01-06	Challenges and Approaches in Short-Wave Infrared Organic Photodiode Design	Chan So	Pohang University of Science and Technology (POSTECH)
01-07	Polymer-Based Spherical Optoelectronic Devices Enabled by Gyroscopic Deposition	Taekmin Kim	Pohang University of Science and Technology (POSTECH)
01-08	Dual-Interface Engineering of the Source Electrode in Organic Schottky Barrier Transistors for a Record On/Off Ratio	Hye Ryun Sima	Pohang University of Science and Technology (POSTECH)
01-09	Robustly Doped Proquinoidal-Based Conjugated Polymers for Direct Short-Wave Infrared Photothermoelectric Devices and Detectors	Guan-Lin Chen	National Taiwan University
01-10	Structural Design of 2D Dion-Jacobson Tin Perovskites via Alkyl Chain Spacer Modulation for Efficient Charge-Transporting Semiconductors	Wantae Park	Pohang University of Science and Technology (POSTECH)
01-11	A Chloride-Based Crystallinity Control Strategy for High-Performance 2D Tin Halide Perovskite Transistors	Hyoungha Ryu	Pohang University of Science and Technology (POSTECH)
01-12	Retarding Degradation of Perovskite Thin Film with Lead Bication Thiocyanate Salt	Siwon Yun	Chungnam National University
01-13	Investigating Mechanism of Enhanced Photostability in Passivated Perovskite Solar Cells via Anti-solvent Additives	Wonjong Lee	Chungnam National University
01-14	Elucidating the Lead Halide Perovskite Crystallization via Optoelectronic Measurement	Hyeji Han	Chungnam National University
01-15	Wafer-Scale Electronics Enabled by Direct Photopatterning of Green Solvent-Processed 2D Nanomaterials	Wan Ho Cho	Ulsan National Institute of Science and Technology (UNIST)
01-16	Optimization of Recognition-Site Localization in Side-Gated Organic Electrochemical Transistor Immunosensors	Jiyoul Lee	Pukyong National University
01-17	Synergistic Conformal of Multifunctional Phenothiazine-Based Self-Assembled Monolayers for Better Interface Contact in High-Efficient and Stable Perovskite Solar Cells	Qurrotun Ayuni Khoirun Nisa	Pukyong National University
01-18	Multi-site Interaction of Ligands for High Performance Perovskite Solar Cells	Jinhyuk Choi	Pohang University of Science and Technology (POSTECH)
01-19	Room-Temperature Magnetic-Field-Free Circularly Polarized Luminescence from Individual Perovskite Quantum Emitters	Hung-Ming Chen	National Tsing Hua University
01-20	Stabilizing CsPbI3 Quantum Dots in Polar Solvents via Zwitterion Passivation	Tzu-Hao Liao	National Tsing Hua University
01-21	High Mechanical Durability in Intrinsically Stretchable Neuromorphic Devices via Phase-Programmed Semiconducting Polymers	Kwan-Nyeong Kim	Seoul National University
01-22	Four-dimensional (x, y, z, t) photoluminescence dynamics for probing vertical charge transport in perovskite solar cells	Boseung Je	Pohang University of Science and Technology (POSTECH)

Poster session 1 / 11.13 (Thu)			
No.	Title	Presenter	Affilation
01-23	Perovskite quantum dots improve the efficiency of organic solar cells through synergistic enhancements in light absorption, exciton transport, and interfacial dipole alignment	Dong Hwan Son	Pukyong National University
01-24	Vertical phase separation induced highly efficient pseudo-bilayer photoanodes for organic photoelectrochemical cells	Soonyong Lee	Korea University
01-25	DECONVOLUTING PL SPECTRA IN MIXED-HALIDE PEROVSKITES: INSIGHTS INTO PHASE SEGREGATION VIA DUAL FITTING MODEL	Asawar Batool	Chungnam National University
01-26	Fabrication of Inorganic Perovskite Thin Film Using Vacuum Deposition System	Minkyu Kim	Chungnam National University
01-27	Defect Management and Charge Dynamics Regulation by Cesium-Doped SnO2 for Highly Efficient and Stable Perovskite Solar Cells	Muhammad Adnan	Chungnam National University
01-28	Strain Regulation and Defect Passivation with 2D Organic Halide Salts for Air-Stable Perovskite Solar Cells	Zobia Irshad	Chungnam National University
01-30	Development of Sulfur-Containing Narrowband Emitters with Exquisitely Tuned Luminescence Colors	Daiki Endo	Kyushu University
01-31	Color-Tunable Narrowband Delayed Fluorescence in Peripherally Dendritic Modified Bis-Indolocarbazoles	Jun Hyeon Lee	Kyushu University
01-32	Development of Pyriidopyrimidine-Containing Conjugated Polymer for Outdorr and Indoor Photovoltaics	Jiahui Duan	Kyushu University
01-33	Computational Study on tBP Free Hole Transport Layer for Stable and Efficient Perovskite Solar Cells	Dong Gyu Lee	Gyeongsang National University
01-34	Thermodynamic Analysis of YCl3/ZnCl2 Additives for Improving Efficiency and Long-Term Stability of Quasi-2D Perovskite LEDs	Sang Wook Park	Gyeongsang National University
01-35	Computational Insights into Alkyl Diammonium Ligands Considering Strain-Induced Inhomogeneity in All-Perovskite Tandem Solar Cells	Jun Hyeok Choi	Gyeongsang National University
01-36	Molecular-Level Insights into Doping Mechanisms of Conjugated Polymers	Yubhin Cho	Gyeongsang National University
01-37	Transformable and Adhesive Nanomembranes for Skin-conformal and High-Performance Soft Bioelectronics	Daeyeon Lee	Ulsan National Institute of Science and Technology (UNIST)
01-38	Understanding Redox Mechanism and Ion Transport in NDI-Based Polymers via Multiscale Simulations	Hyeonsu Son	Gyeongsang National University
01-39	Tailored Thermoelectric Performance of Tetrasubstituted Thieno[3,2-b]thiophene-Based Small Molecule/Carbon Nanotube Composite Materials	Yu-Chuan Liu	National Taiwan University
01-40	Solution-processed Ag2S thin films exhibiting low-voltage, high-performance bipolar resistive switching	Yoonjin Cho	Pohang University of Science and Technology (POSTECH)
01-41	Angle-dependent magneto-photoconductance modulated by a photoinduced fringe field-like effect in non-ferromagnetic pentacene/fullerene planar heterojunction	Anas Mujahid	National Cheng Kung University
01-42	Doping Effect and Electrical Behavior of Spiro-MeOTAD Films	Tatsuo Mori	Aichi Institute of Technology
01-43	Unanticipated Interfacial Redox Reaction in the NiOx Transport Layer of Perovskite Light-Emitting Diodes	Thi-Hoai Do	National Cheng Kung University
01-44	Physical Vapor co-deposition of lead-free halide perovskite $CsSn_{1-x}Zn_xBr_3$ and fabrication of inverted solar cells	Hanbo Jung	Kyushu university
01-45	Photon Recycling Effects and Electroluminescence in Perovskite Solar Cells	Jeongheon Park	Pohang University of Science and Technology (POSTECH)

Poster session 1 / 11.13 (Thu)			
No.	Title	Presenter	Affilation
01-46	Patternable Micro Electric Wires: Liquid Metal-Elastomer Core-Shell Electrodes	Safina Saidova	Korea Advanced Institute of Science and Technology (KAIST)
01-47	Photocatalytic hydrogen generation of Simplified Y6-Derivatives	Min Gyu Kang	Korea University
01-48	Conjugated Oligoelectrolyte-Driven Self-Assembled Monolayer for Bidirectional Interfacial Engineering in Sn-Pb Perovskite Solar Cells	Jong Bin Park	Korea University
01-49	Tuning Crystallization of Industry Compatible Evaporation-Solution Method Wide Bandgap Perovskite for Perovskite/Silicon Tandem Solar Cells on Commercial Silicon Bottom Cells	Yu-Ting Chen	National Cheng Kung University
01-50	Halogen Substitution in Non-Fullerene Acceptors for High-Performance Near-Infrared Organic Photodetectors and Semi-Transparent Solar Cells	Ji Yeon Son	Ajou University
01-51	Improving Stability of Blue Pt(II) Complex for Long Operational Lifetime Blue PhOLED	Young Hun Jung	Kyunghee University
01-52	Synergistic Indolocarbazole Stitching and Peripheral Acceptor Engineering Enable Narrowband Green MR-TADF Emitters For High-Efficiency, Long-Lifetime OLEDs	Hai Truyen Dang	Kyunghee University
01-53	Machine Learning- Driven Design of Sterically Protected High-Triplet Exciplex Hosts for Efficient Green OLEDs	Truong Thi Thuy	Kyunghee University
01-54	Exciplex Host Engineering for High Efficiency and Operational Stability of Green PSF Technology	Pavan Kumar Odugu	Kyunghee University
01-55	Stable n-Doped Electron Transport Materials for High-Efficiency and Long-Lifetime Tandem Blue OLEDs	Subramanian Muruganantham	Kyunghee University
01-56	Metallic-interlayer assisted liquid metal electrode for high performance intrinsically stretchable organic solar cells	Seungbok Lee	Korea Advanced Institute of Science and Technology (KAIST)
01-57	Suppressing Hole Accumulation through Sub-Nanometer Dipole Interfaces in Hybrid Perovskite/Organic Solar Cells for Boosting Near-Infrared Photon Harvesting	Min Seok Kim	Korea Advanced Institute of Science and Technology (KAIST)
01-58	Improved Performance of Perovskite Quantum Dot Photodetectors through Halide Vacancy Suppression via Phosphine-Based Ligand Engineering	Byeongchan Park	Pohang University of Science and Technology (POSTECH)
01-59	Impact of Fluorination on Exciton Dissociation and Interchain Polaron Formation in Push-Pull Conjugated Polymer Aggregates	Hyeokgu Yun	Pohang University of Science and Technology (POSTECH)

Poster session 2 / 11.14 (Fri)			
No.	Title	Presenter	Affilation
02-01	Low-temperature Photo-Crosslinkable, Highly Moisture-Resistant, and Flexible Encapsulant for Versatile Organic and Hybrid Optoelectronic Devices	Gyeongguk Jeon	Ajou University
02-02	A High-Performance Transpiration-Driven Electrokinetic Power Generator Using a Conjugated Polymer	Kyung Min Kim	Ajou University
02-03	Spectrally Flat Broadband Organic Photodetectors with Photoresponse up to 1400 nm via Using a Fused Thiophene-Based Non-Fullerene Acceptor	Ji Hye Yoon	Ajou University
02-04	High-Performance Inverted Perovskite Solar Cells using Carboxylic Acid-Functionalized PTAA as a Hole Transport Layer	Jae Woo Jeong	Ajou University
02-05	Pure Organic Visible-to-UV Solid-state Photon Upconversion based on Metal-free Sensitizer and Glassy Emitter Aggregates	Shun Watanabe	Kyushu University
02-06	Decoupling of Colloidal Perovskite Quantum Dots for Deep-Blue Light-Emitting Diodes	Kyung Yeon Jang	Seoul National University
02-08	Solution-processed growth of SnS2 single crystal	Hyein Hwang	Pohang University of Science and Technology (POSTECH)
02-09	Fabrication of Inorganic 3D Architectures via Chemical Coupling of Nanocrystals	Minseong Park	Pohang University of Science and Technology (POSTECH)
02-10	Aromatic 2,2-diphenyletylamine Ligand Exchange of FA0.9Cs0.1PbBr3 Perovskite Nanocrystals for High Efficiency Pure Green Light-Emitting Diodes	Shoki Mizoguchi	Yamagata university
02-11	Controlling Emission Wavelengths of Sn/Ge Halide Nanocrystals via Mixed Halides Composition	Sana Kakizaki	Yamagata University
02-12	Controlling Morphology and Aggregates Using Volatile Solid Additives to Enhance OPV Performance	Akira Sato	Yamagata University
02-13	Synthesis of Narrow-Luminescent Organic Small Molecules Containing Dibenzofuran	Yu-An Lu	soochow university
02-14	Dibenzofuran-Engineered High Bond Dissociation Energy Hole Transport Materials for Efficiency and Longevity of Quantum Dot Light-Emitting Diodes	Youngjun Hwang	Daegu Gyeongbuk Institute of Science and Technology (DGIST)
02-15	Investigation of Photophysical and Structural Characteristics of Low-Triplet Anthracene-Derived Multiple-Resonance Emitters	Li Cheng-Yang	Soochow University
02-16	Photothermally Cross-Linkable Polymeric Hole Transport Material with Azide Groups for Efficient and Stable Quantum Dot Light-Emitting Diodes	Jaehyeon Kim	Daegu Gyeongbuk Institute of Science and Technology (DGIST)
02-17	Development of Low-Triplet-Energy Multiple-Resonance Emitters Incorporating Pyrene and Anthracene	Yu-Hsuan Chiang	Soochow University
02-18	Benzodifuran as a Building Block for Low-threshold, Stable Organic Laser Emitters	Shota Fukuma	Kyushu University
02-19	Scaffold Induced Phase-controlled Crystallization for Thermally Evaporated Perovskite Light-Emitting Diodes	Chan-Yul Park	Seoul National University
02-20	Unveiling the Effect of Molecular-Weight on Charge Transport and Polaron Formation in Ion-gel Gated Organic Synaptic Transistors	Hyun-Haeng Lee	Seoul National University
02-21	Cost-Effective $(Bi,Sb)_2Te_3$ thermoelectric devices with Designed Voids for Co-Optimized Thermal and Electrical properties	Yae Eun Park	Pohang University of Science and Technology (POSTECH)
02-22	Sequential 3D Printing of Functionally Graded Thermoelectric Materials for Enhanced Energy Conversion	Hyunjin Han	Pohang University of Science and Technology (POSTECH)
02-23	Highly Efficient Fully Stretchable OLEDs with MXene Electrodes	Hyun-Wook Kim	Seoul National University

Poster session 2 / 11.14 (Fri)			
No.	Title	Presenter	Affilation
02-24	Kinetic Monte Carlo Simulation of Time-of-Flight Photocurrent Transients in Amorphous Organic Semiconductors	Hiroyoshi Naito	Osaka Metropolitan University
02-25	Study on the Growth Mechanism of Ruddlesden-Popper Phase (RNH3)2Csn-1PbnBr3n+1 Nanoplatelets using Zwitterionic Ligands	Taesun Yun	Gwangju Institute of Science and Technology (GIST)
02-26	Achieving Chirality in Perovskite Nanocrystals by Post-Treatment of Chiral Ligands	Hyomin Park	Gwangju Institute of Science and Technology
02-27	Stretchable High-k Dielectric Metal Oxide Transistor on Polyimide using Azide-functionalized Coordination Ligand	Suryeon Jang	Pohang University of Science and Technology (POSTECH)
02-28	Red-Emitting CsPb(Br1-xIx)3 Nanocrystals via Thiocyanate-Alkali Metal Doping	Seonjin Lee	Jeonbuk National University
02-29	Top-Emitting RGB Fluorescent OLEDs with Narrowband Emission for High-Speed Visible Light Communication	Jin Hyup Kim	Inha University
02-30	Developing Synthesis of Silane-Based Host for Blue Phosphorescent OLEDs	Seonjeong Lee	Gyeongsang National University
02-31	Synthesis of Indolocarbazole-Based Hosts with Bipolar Characteristics	Eunju Shin	Gyeongsang National University
02-32	Balanced Molecular Design of Benzoselenadiazole π-Bridges and ICT-Enhanced Terminal Units for Highly Sensitive NIR Organic Photodetectors	Lee Un-Hak	Daegu Gyeongbuk Institute of Science and Technology (DGIST)
02-33	Synergistic Alignment of Pt-Based Sensitizer and Thermally Activated Delayed Fluorescence Emitters for High-Performance Phosphor-Sensitized Fluorescent Organic Light-Emitting Diodes	Lee Daeun	Inha University
02-34	Exciton quenching behaviors in 4CzIPN-based emission layers and their host material dependence studied by DCM-PL technique	Kotaro Kudo	Meiji University
02-35	Ultra-Sensitive Short-Wave Infrared Organic Photodetectors Enabled by a π-Conjugation Extended Proquinoid Electron Acceptor	Yeonsu Choi	Korea Research Institute of Chemical Technology
02-36	Polarization-Driven Electron Injection for Enhanced Organic Light Emitting Diode Performance	Amarja Katware	Inha University
02-37	The Effects of Methoxy Functionalization of Diketopyrrolopyrrole Based Conjugated Polymers on The Doping and Thermoelectric Properties	Landep Ayuningtias	Gyeongsang National University
02-38	Achieving Stable Ambipolar and Unipolar Transport in NDI-DPP-Thiophene Copolymers for Organic Transistors	Karina Ayu Larasati	Gyeongsang National University
02-39	Engineering Conformational Degrees of Freedom of Semiconducting Polymers in Solutions toward Controllable Liquid-Phase Molecular Assembly	Ben Hsu	National Cheng Kung University
02-40	DCM-EL study of relaxation processes in polyfluorene-derivative-based light-emitting electrochemical cells	Ryota Takubo	Meiji University
02-41	Comparative study on conjugated additives for efficient and stable perovskite solar cells	Haicheng Xia	Pukyong National University
02-42	Phenothiazine-based self assembled monolayers for systematically modulating interfacial dipole moments in perovskite solar cells	Eunhye Yang	Pukyong National University
02-43	Impact of Charge Accumulation on Device Degradation in Organic Solar Cells Studied by Displacement Current Measurement	Yuki Miyazawa	Meiji University
02-44	Fully Automated OLED Fabrication: A New Standard for Process Consistency	Seungchan Ham	Inha university
02-45	Aggregation optimization by molecular engineering of D18-based terpolymer for highly-efficient indoor organic solar cells	Se Jeong Park	Korea Research Institute of Chemical Technology

Poster session 2 / 11.14 (Fri)			
No.	Title	Presenter	Affilation
02-46	Crystallinity Engineering through Co-Additives for Improved Charge Transport and Op	Junpyo Lee	Seoul National University
02-47	Electrochemical Doping in Perovskites for Reconfigurable Photodiodes	Yongjin Kim	Seoul National University
02-48	Standardisation of Gate-Dependent Mobility Measurements in Organic Electrochemic	Youhyun Nam	Seoul National University
02-49	Enhancing Mixed Transport in Donor-Acceptor Polymers via Electrochemical Doping-	Tae Hoon Kim	Seoul National University
02-50	Mechanochemical Engineering of 0D/1D Ternary Metal Halide Heterostructure for Wh	Jaeyoon Cho	Seoul National University
02-51	Dual-functional Additive Strategy for Stable and Efficient Lead-based Halide Perovskit	Jungyoon Choi	Seoul National University
02-52	Solid Polymer Electrolyte Gated Tin Halide Perovskite Field-Effect Transistors	Taemin Jung	Seoul National University
02-53	Volatile Pseudohalide-Assisted Crystallization of Phase-Pure Quasi-2D Tin Halide Pe	Hyeonmin Choi	Seoul National University
02-54	High-Efficiency Narrowband Red PSF OLEDs Achieving BT.2020 with Ultralow Roll-Off and Long Operational Lifetime	Meghana Tirupati	Kyunghee University
02-55	Engineered Anthracene-Naphthobenzofuran Hosts for High-Performance Blue Fluorescent OLEDs	Aradhya Rajput	Kyunghee University
02-56	Extending the Photodetection Limit of Organic Photodiodes Beyond 1,000 nm via an Open-Shell Terpolymer	Moon-Ki Jeong	Seoul National University
02-57	Suppressing Aggregation through a Rigid DOBNA-Based Host for Ultralong-Lifetime Red Solution-Processed OLEDs	Yeonjoo Lee	Gyeongsang National University
02-58	Photoelectrochemical cells with all-organic photoanodes	Jiwoo Yeop	Gyeongsang National University

[PL 01]

Unveiling the Fundamentals of OLEDs: Mechanisms of Emission and Charge Transport

Hironori Kaji
Institute for Chemical Research, Kyoto University, Gokasho, Uji, Kyoto 611-0011, Japan
Email: kaji@scl.kyoto-u.ac.jp

Keywords: organic light-emitting diodes (OLEDs), quantum chemical calculations, thermally activated delayed fluorescence (TADF), quantitative rate constant prediction, Alzheimer's disease

We are conducting research on organic light-emitting diodes (OLEDs) in the following aspects: 1) high-throughput development of thermally activated delayed fluorescence (TADF) materials for realizing highly efficient OLEDs,[1-3] 2) exploration of materials with inverted singlet-triplet energy gaps (iST),[4-5] 3) quantitative prediction and mechanistic understanding of emission processes in OLEDs based on comprehensive quantum chemical calculations,[6] 4) quantitative prediction and fundamental analysis of charge transport in OLEDs through multiscale simulations,[7-9] and 5) NMR analysis targeting OLED materials and devices.[10] In particular, we have recently developed a theoretical methodology that enables the quantitative prediction of all emission-related rate constants and quantum yields associated with electronic transitions in OLEDs, as well as the time evolution of exciton populations.[6] This versatile approach is applicable to a wide variety of different systems and has recently been extended to organophotocatalysts for Alzheimer's disease.[11,12] In the presentation, we will also discuss further developments of this study.

[References]

(1) Kaji, H., et al., *Nat. Commun*. **2015**, 6, 8476.

(2) Wada, Y.; Nakagawa, H.; Matsumoto, S.; Wakisaka, Y.; Kaji, H., *Nat. Photon*. **2020**, 14, 643.

(3) Yasuda, Y.; Shizu, K.; Tanaka, H.; Kaji, H., *Angew. Chem. Int. Ed*. **2025**, 64, e202504390.

(4) Kusakabe, Y.; Shizu, K.; Tanaka, H.; Tanaka, K.; Kaji, H., *Appl. Phys. Express* **2024**, 17, 061001.

(5) Okumura, R., et al., *Angew. Chem. Int. Ed*. **2024**, e202409670.

(6) Shizu, K.; Kaji, H., *Nat. Commun*. **2024**, 15, 4723.

(7) Kubo, S.; Kaji, H., *Sci. Rep*. **2018**, 8, 13462.

(8) Sato, H.; Kanda, S.; Kaji, H., npj *Comput. Mater*. **2025**, 11, 39.

(9) Ishihara, K.; Kaji, H., *Commun. Mater*. **2025**, 6, 116.

(10) Suzuki, K.; Kaji, H., *J. Am. Chem. Soc*. **2023**, 145, 16324.

(11) Furuta, M., et al., *Adv. Sci*. **2024**, 11, 2401346.

(12) Yamane, M., et al., *J. Am. Chem. Soc*. **2025**, 147, 28860.

`

[PL 02]

Next-Generation Imaging and Energy Conversion with Organic Upconversion, UV Detectors, and Perovskite Electronics

Shun-Wei Liu
[1]Organic Electronics Research Center and Department of Electronic Engineering,
Ming Chi University of Technology, New Taipei City 243303, Taiwan
[2]Center for Sustainability and Energy Technologies, Chang Gung University, Taoyuan 33302, Taiwan
Email: swliu@mail.mcut.edu.tw

Keywords: Organic Imagers, Upconversion, Invisible light, Perovskite Electronics

We have advanced organic upconversion imaging by seamlessly integrating organic infrared photodetectors with OLEDs, enabling real-time infrared-to-visible visualization. This breakthrough, with significant implications for anti-surveillance technologies, was highlighted in Nature 1. Our early demonstrations achieved a turn-on voltage below 1.7 V, resolution beyond 1500 ppi, visible transparency above 65%, and IR sensitivity below 1 μW/cm² 2-3. Building on this foundation, we introduced a tandem OLED architecture incorporating a charge generation layer, attaining an upconversion efficiency over 30% 4. More recently, we realized an all-solution-processed upconversion imager based on Zn-doped $CsPbBr_3$ quantum dots, thereby integrating disparate material systems within a single device 5. To extend spectral reach into the SWIR regime, we employed non-fullerene acceptors, enabling detection across 0.9-1.5 μm 6. This platform has further been applied toward biosensing, including the detection of African Swine Fever.

Beyond upconversion systems, we have developed high-gain organic ultraviolet photomultiplier-type photodetectors (UV PMT-PDs) with detectivity exceeding 10^{15} Jones, offering unprecedented sensitivity across the UV-A/B spectrum for emerging wearable and flexible platforms. We have also realized fully vacuum-deposited perovskite visible photodetectors employing ultra-thin, spatially uniform films. These devices exhibit low dark current, wide linear dynamic range, and high imaging uniformity—key metrics for next-generation multispectral arrays. Furthermore, our vacuum-deposited perovskite films can efficiently harvest indoor illumination, achieving over 42% power conversion efficiency under 300 lux (TLD 840), underscoring their potential for low-light energy harvesting.

This presentation will highlight our integrated strategies across organic and hybrid optoelectronic systems, emphasizing the fundamental physics, device architectures, and scalable processing routes that enable high-performance imaging and sensing technologies.

[References]

(1) *Nature*, 617 (**2023**) 227

(2) C. J. Shih, Y. Z. Li, M. Z. Li, S. Biring, B. C. Huang, C. W. Liu, T. H. Yeh, D. Luo, J. H. Lee, Y. H. Huang, K. T. Wong, S. W. Liu, *Nano Energy* **2021**, 86, 106043.

(3) *Sci. Adv*., 9 (**2023**)

(4) C. J. Shih, C. Y. Lin, K. Chen, N. R. A. Amin, D. Luo, I. S. Hsu, A. K. Akbar, S. Biring, C. H. Lu, B. H. Chen, S. D. Yang, J. H. Lee, S. W. Liu, *Adv. Sci*. **2023**, 10, 2302631

(5) L.-C. Chen, S.-A. Chen, K. Uma, C.-H. Chiang, J.-X. Xie, Z.-L. Tseng, S.-W. Liu, *Adv. Funct. Mater*. **2024**, 34, 2309589.

(6) J. Cong, Z.-H. Huang, S.-W. Liu, Z. Luo, F.-Z. Liu, Z. Chen, K.-M. Lee, Y.-C. Huang and C. Yang, *Small*, **2025**, 21, 2410418

[PL 03]

Dual-Mode Narrowband Near-Infrared Organic Photodetectors

Furong Zhu
Department of Physics, Hong Kong Baptist University, Kowloon Tong, Hong Kong, China.
Email: frzhu@hkbu.edu.hk

Keywords: organic photodetectors, near-infrared detection, narrowband spectral response, double bulk heterojunction architecture.

The spectral response of organic photodetectors (OPDs) is typically governed by the absorption characteristics of the active materials and the optical profile within the devices. While single-band OPDs optimized for specific spectral ranges have been extensively studied, reports on OPDs capable of spectrally selective detection are rather rare. Achieving high-performance multispectral OPDs presents a significant challenge. Traditional photodetectors typically respond to a broad range of wavelengths and lack the precision to separate (700–900 nm) from NIR-II (1000–1700 nm). This makes it difficult to obtain the clear, band-specific images needed for specialized applications. This talk discusses a bias-switchable dual-mode narrowband OPD that features a back-to-back stacked double bulk heterojunction (BHJ) architecture1-5. The front junction is sensitive to short-wavelength light, while the rear junction is responsive to long wavelength light. This double BHJ OPD enables spectral selective detection, controlled by the polarity of the bias applied between the two contacts of the dual-mode OPD. The dual-mode OPDs open new possibilities for applications in areas such as security monitoring, artificial intelligence, imaging in distinct bands, and optical communication.

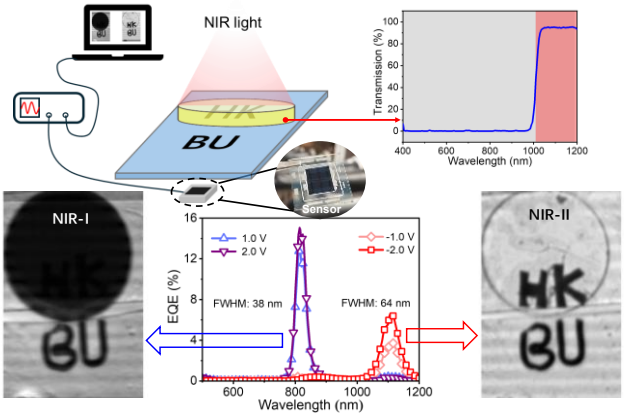


Fig. 1. Demonstration of dual-mode narrowband OPD capable of "seeing" in two separate windows of NIR light, NIR-I (700–900 nm) and NIR-II (1000–1700 nm).

[References]

(1) Tang, Y.; Wang, Z.; Gao, M.; Han, J. H.; Yuan, L.; Zhu, F. Dual-mode narrowband organic photodetectors for self-aligned imaging in NIR-I and NIR-II. *Nat. Commun.* **2025**, *16*, 7144,.

(2) Z. M. Wang, Y. Tang, J. Y. Han, F. R. Zhu, *Appl. Phys. Lett.* **2024**, 124, 021103

(3) Z. Lan, Y. Lei, W. K. E. Chan, S. Chen, D. Luo, F. Zhu, *Sci. Adv.* **2020**, 6, eaaw8065.

(4) N. Li, Z. Lan, Y. S. Lau, J. Xie, D. Zhao, F. Zhu, *Adv. Sci.* **2020**, 7, 2000444.

(5) Z. J. Lan, Y. S. Lau, L. F. Cai, J. Y. Han, C. W. Suen, F. R. Zhu, *Laser Photonics Rev.* **2022,** 16, 2100602.

[PL 04]

Evolution of Organic Semiconductor Materials: From Molecular Design to Device Applications

Dong Hoon Choi
Department of Chemistry, Korea University, 145 Anam-ro, Seongbuk-gu, Seoul 02841, Korea
Email: dhchoi8803@korea.ac.kr

Keywords: Organic semiconductor, conjugated molecule, thin film transistor, organic photovoltaics, organic light emitting diodes

Organic semiconductors (OSCs) are key materials for next-generation flexible electronics and solution/vacuum-processable optoelectronic devices. This presentation will introduce our laboratory's research on the molecular design and synthesis of organic semiconductors (OSCs), encompassing small, medium, and polymeric materials. In addition, we will highlight various application examples that employ multiscale architectures, from the molecular to the nanoscale, aimed at enhancing performance and sustainability.[1-3] For example, at the molecular level, selenium-substituted DPP-based conjugated polymers with optimized side chains improved π–π stacking and achieved charge mobility over 1.5 $cm^2V^{-1}s^{-1}$ in OTFTs. Microscopically, template-guided solution-shearing (TGSS) formed micro-sized structures for anisotropic molecular alignment and controlled charge pathways. Nanoscale strategies yielded single-crystal-like polymer nanowires (PNWs) for high-performance nanowire FETs. However, many approaches depend on environmentally harmful halogenated solvents. To address this, we developed green processing strategies involving precise molecular design for compatibility with non-toxic solvents. Notably, all-polymer solar cells using halogen-free solvents achieved over 9.7% efficiency and high stability.[3] In OLEDs, sterically hindered TADF emitters enabled 14% EQE with eco-friendly solvents like ethyl acetate. Together, these multiscale strategies offer a comprehensive framework for improving performance, reproducibility, and sustainability in OSC-based electronics, paving the way for environmentally responsible material design and processing.

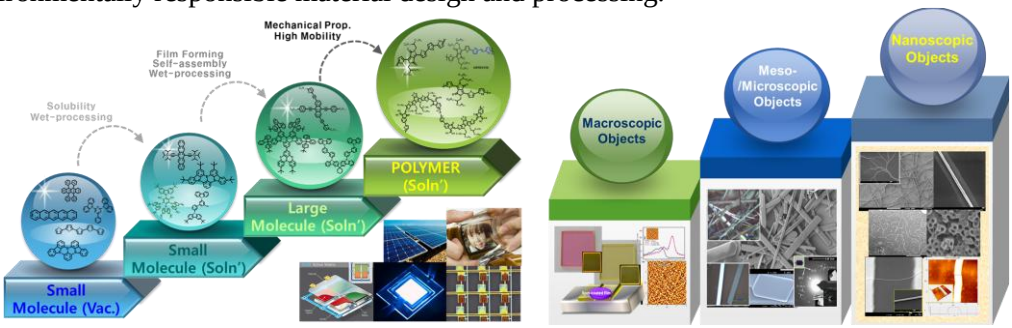


Figure 1. Multiscale evolution of organic semiconductor materials: from small molecules to polymers and from macroscopic to nanoscopic architectures for advanced applications.

[References]

(1) J. H. Kim, D. H. Lee, D. S. Yang, D. U. Heo, K. H. Kim, J. Shin, H.-J. Kim, K.-Y. Baek, K. Lee, H. Baik, M. J. Cho, D. H. Choi, *Adv. Mater*. **2013**, 25(30), 4102.

(2) J. Shin, T. R. Hong, T. W. Lee, A. Kim, Y. H. Kim, M. J. Cho, D. H. Choi, *Adv. Mater***. 2014**, 26(34), 6031.

(3) G. E. Park, S. Choi, S. Y. Park, D. H. Lee, M. J. Cho, D. H. Choi, *Adv. Energy Mater*. **2017**, 7(19), 1700566.

(4) S. H. Park, N. Y. Kwon, C. W. Koh, J. Y. Park, M. J. Kang, H. Kwak, C. Y. Park, S. Park, M. J. Cho, D. H. Choi, *Chem. Eng. J.* **2024**, 481, 148484.

[PL 05]

Engineering Disorder and Carrier–Dopant Interactions in Doped Conjugated Polymers for Enhanced Charge Transport

Kilwon Cho
Dept. of Chemical Engineering, Pohang University of Science and Technology, Pohang 37673, Korea
Email: kwcho@postech.ac.kr

Keywords: Conjugated polymer, Doping, Charge transport, Structural and energetic disorder

Doping in conjugated polymers has become a central approach to tailor their electrical and thermoelectric properties, driving progress in organic electronics and related energy technologies. The process inevitably induces structural and energetic disorder that broaden the density of states, along with carrier–dopant interactions. Together, these factors constrain carrier mobility and conductivity, particularly at high doping levels. In this talk, I will present recent progress in understanding how disorder and carrier–dopant coupling govern charge transport in doped conjugated polymers. By correlating microstructural changes, energetic landscape, and transport behavior, important insights are emerging into the origins of transport limitations. I will also highlight strategies to reduce disorder, to manage energetic broadening for more efficient carrier generation, and to mitigate unfavorable carrier–dopant interactions. These results point toward emerging design principles for developing high-performance doped conjugated polymers that combine enhanced charge transport with improved stability, supporting their use in future organic electronic and thermoelectric devices.

[IV 01-1]

Endothermic singlet fission process in harvesting the high-level excitation energy for tetracene-based photodiodes

Anas Mujahid[a], Chien-Chih Wu[a], Shi-Hong Luo[a], Chao-Hsien Hsu[b], Bo-Han Chen[c], Chih-Hsuan Lu[c], Wei-Zong Feng[c], Shang-Da Yang[c], Pi-Tai Chou[b], Tzung-Fang Guo[a,d,e,f,#,*]
[a]Department of Photonics, National Cheng Kung University, Tainan, Taiwan
[b]Department of Chemistry, National Taiwan University, Taipei, Taiwan
[c]Institute of Photonics Technologies, National Tsing Hua University, Hsinchu, Taiwan
[d]Program on Key Materials, Academy of Innovative Semiconductor and Sustainable Manufacturing, National Cheng Kung University
[e]Research Center for Applied Sciences, Academia Sinica, Taipei, Taiwan
[f]Research Center for Critical Issues, Academia Sinica, Tainan, Taiwan
Email: guotf@mail.ncku.edu.tw, guotf@as.edu.tw

Keywords: High-level excitation energy, singlet fission, triplet-triplet pair, magneto photoluminance, tetracene-based photodiode

Singlet fission (SF) provides a viable mechanism to surpass the Shockley-Queisser efficiency limit in photovoltaic devices, where excitation energy plays a pivotal role in modulating the SF process. In this study, the SF dynamics are systematically characterized by measuring magneto-photoluminescence (MPL) under two distinct excitation wavelengths (403 nm and 440 nm) in a tetracene-based thin film. High-energy excitation (403 nm) yields a higher MPL intensity, indicating a higher degree of SF in the absence of an external magnetic field. These results suggest that excitation energy significantly modulates SF and influences the triplet-triplet 1(TT) pair separation. To confirm this, temperature-dependent MPL measurements reveal the activation energies of 53.36 meV and 68.61 meV, corresponding to the energy required for 1(TT) pair separation for 403 nm and 440 nm excitation, respectively. Moreover, the incident photon-to-current efficiency (IPCE) measurements of the tetracene-based photodiode exhibit a relatively high response in the 300-400 nm wavelength range, peaking at 380 nm as illustrated in Fig. 1. Notably, the integrated current density (J) within this spectral region contributes approximately 31% to the total photocurrent. These results indicate the possibility of harvesting high-level excitation energy through SF in a tetracene-based photodiode and suggest the importance of 1(TT) pair separation in optimizing the SF-based photovoltaics[1].

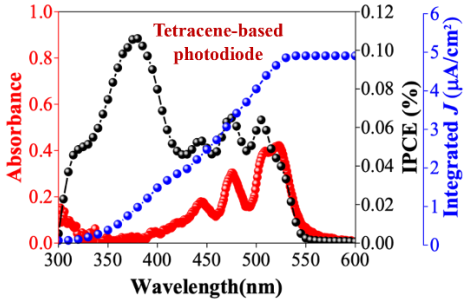


Fig. 1. The absorbance of the pristine tetracene thin film (red line), the IPCE spectra (black line), and the integrated J curve (blue line) of the tetracene-based photodiode. The J within 300-400 nm spectral region contributes approximately 31% to the total photocurrent.

[References]

(1) A. Mujahid, C. -C. Wu, S. -H. Luo, C. -H. Hsu, B. -H. Chen, C. -H. Lu, W. -Z. Feng, S. -D. Yang, P. -T. Chou, T. -F. Guo*, *Adv. Opt. Mater.* **2025**.

[IV 01-2]

Nanocrystalline Perovskite Emitter for Future Displays

Tae-Woo Lee[#,*]
Department of Materials Science and Engineering, Research Institute of Advanced Materials, Soft Foundry, Interdisciplinary Program in Bioengineering, Institute of Engineering Research, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Republic of Korea
Email: twlees@snu.ac.kr

Metal halide perovskites (MHPs) have emerged as promising light emitters for future display technology and optoelectronic applications due to their excellent color purity, tunable bandgaps, and high photoluminescence quantum yield. With the expanding scope of display applications, particularly in AR/VR devices, there is an increasing demand for light emitter that can deliver more vivid and accurate colors, meeting next-generation color standard of Rec. 2020. This presentation explores advanced strategies to improve the efficiency of perovskite light-emitting diodes (PeLEDs), which offer precise wavelength control and narrow FWHM.

To enhance PeLED luminescence efficiency, strategies such as doping guanidinium (GA) cations into formamidinium lead bromide (FAPbBr3) perovskite nanocrystals (PNCs) and overcoating with bromide-incorporated molecules are employed to stabilize PNCs and passivate defects[1] . The use of a core/shell structure with benzylphosphonic acid in PNCs further boosts efficiency, brightness, and stability in PeLEDs[2]. Additionally, hybrid tandem PeLEDs with optimized optical structures have achieved near-perfect charge balance and improved outcoupling efficiency, setting new standards in display technology[3]. Finally, the use of surface-binding conjugated molecular multipods to strengthen the perovskite lattice and reduce dynamic disorder has significantly improved the luminescent efficiency of PeLEDs[4]. Besides, the novel perovskite-organic solid solution structure will be introduced that realize deep-blue emission PeLEDs[5].

In addition to self-emissive PeLEDs, significant progress has been made in color-conversion type displays. PNCs with multi-layer shell structures demonstrate enhanced stability under 60°C and 90% relative humidity, and under high light flux. These ultra-stable PNCs have led to the development of high-efficiency and stable perovskite down-converting LEDs, achieving over 95% of the Rec. 2020 color space, demonstrating the commercial potential of PeNCs.

[Reference]

(1) Y.-H. Kim, S. Kim, A. Kakekhani, A. M. Rappe, T.-W. Lee et al., *Nat. Photonics*, **2021**, 15, 148.

(2) J. S. Kim, J.-M. Heo, T.-W. Lee et al., *Nature*, **2022**, 611, 688.

(3) H.-D. Lee, S.-J. Woo, S. Kim, T.-W. Lee et al., *Nat. Nanotechnol.*, **2024**, 19, 624.

(4) D.-H. Kim, S.-J. Woo, C. P. Huelmo, M.-H. Park, A. M. Rappe, T.-W. Lee et al., *Nat. Commun*., **2024**, 15, 6245

(5) K.-Y. Jang, S. Y. Hwang, T.-W. Lee etal. *Adv. Mater*. **2024**. 2404856

[IV 01-3]

Surface-Engineered Perovskite Nanocrystals for Advanced Optoelectronic Applications

Takayuki Chiba[#,*]
Graduate School of Organic Materials Science, Yamagata University, 4-3-16 Jonan,
Yonezawa, Yamagata 992-8510, Japan
Email: T-chiba@yz.yamagata-u.ac.jp

Keywords: perovskite nanocrystals, aromatic ligand, ligand exchange, light-emitting diodes.

Metal halide perovskite nanocrystals have emerged as promising materials for optoelectronic applications owing to their high photoluminescence quantum yields, narrow emission line widths, and wide tunability across the visible spectrum. A key factor determining their processability and device performance is the surface chemistry governed by organic ligands. Conventional long-chain alkyl ligands ensure colloidal stability but hinder charge transport and film integration.

In this study, we explore post-synthetic surface modification strategies designed to balance stability with functionality. Tailored ligand exchange and surface treatments were applied to fabricate diverse film architectures, including inkjet-printed patterned films, host-dispersed composite layers, and layer-by-layer assembled structures. These approaches improved film uniformity, optical properties, and environmental stability, while maintaining high emission efficiency [1-5].

[References]

(1) H. Abe, M. Uwano, R. Kobayashi, K. Narazaki, T. Akiyama, Y. Ito, D. Yokota, T. Oto, S. Nishitsuji, R. Yamakado, T. Chiba, *Small*, **2025**, 21, 2501159.

(2) S. Mizoguchi, S. Sumikoshi, H. Abe, Y. Ito, R. Yamakado, T. Chiba, *ACS Omega* **2024,** 9, 34692−34699.

(3) S. Ohisa, G. Motomura, S. Mizoguchi, Y. Fujisaki, T. Chiba, *Adv. Opt. Mater*. **2024**, 2401456.

(4) K. Satake, K. Narazaki, H. Abe, K. Yanagihashi, M. Mizukami, Y.i Suzuri, T. Chiba, J. Kido, *ACS Appl. Nano Mater*. **2024**, 7, 11313−11319.

(5) F.-C. Liang, F.-C. Jhuang, Y.-H. Fang, J.-S. Benas, W.-C. Chen, Z.-L. Yan, W.-C. Lin, C.-J. Su, Y. Sato, T. Chiba, J. Kido, C.-C. Kuo*, *Adv. Mater*. **2023**, 35, 2207617

[IV 01-4]

Scalable fabrication of perovskite solar cells via magnetron sputtering

Dechun Zou [a,#,*], Shaocong Hou [b]
[a] Beijing National Laboratory for Molecular Sciences, College of Chemistry and Molecular Engineering, Peking University, Beijing, China
[b] School of Electrical Engineering and Automation, Wuhan University, Wuhan, China
Email: dc.zou@pku.edu.cn

Keywords: Perovskite, Magnetron sputtering, Solar cell, Film deposition

Halide perovskite solar cells (PSCs) have achieved a certified efficiency of 26.1%, demonstrating considerable commercialization potential. Magnetron sputtering is a widely used industrial deposition technique. It offers excellent control over film crystallization, high repeatability, and scalability, making it highly suitable for fabricating uniform, large-area perovskite films and PSCs. Currently, most magnetron-sputtered perovskite layers are prepared via a two-step process involving the conversion of sputtered metal compound precursors. Although uniform perovskite films (100 cm2) and PSCs (1.1 cm2) have been realized, the complex conversion process complicates crystallization control, resulting in poor film quality and a low efficiency of 14.1%.

Herein, we deposited perovskite films through one-step magnetron sputtering using targets synthesized via a mechanochemical method. By regulating the target composition (introducing MACl and MABr) and applying post-treatment (MAI and MA vapor), we achieved perovskite films with large grain sizes and low defect density. In addition, we found that the sputtering time can be utilized to precisely tune the elemental stoichiometry and microstructure of the perovskite film. As a result, FAPbI3-based PSCs attained a power conversion efficiency (PCE) of 20.1% and retained over 87% of their initial performance after 600 hours in a nitrogen environment. Furthermore, interface modifications using PEAI and PCBM passivation layers helped mitigate sputtering-induced defects and enhance charge extraction. Finally, we successfully fabricated PSCs with all functional layers deposited by magnetron sputtering, paving a promising route toward the industrial production of high-performance perovskite photovoltaics.

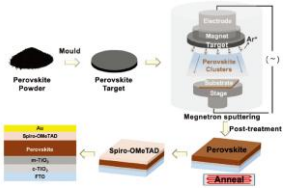


Fig. 1 The scheme of the perovskite layer preparation process via sputtering and the post-treated process.

[References]

(1) B. Gao, J. Hu, S. Tang, X. Xiao, H. Chen, Z. Zuo, Q. Qi, Z. Peng, J. Wen, D. Zou, *Adv. Sci*., **2021**, 8, 2102081.

(2) B. Gao, J. Hu, Z. Zuo, Q. Qi, Z. Peng, H. Chen, K. Yan, S. Hou, D. Zou, *ACS Appl. Mater. Interfaces*, **2022**, 14, 40062.

(3) B. Gao, Z. Zuo, J. Hu, L. Jin, Q. Qi, Z. Peng, S. Hou, Y. Fu, D. Zou, *Adv. Funct. Mater*., **2024**, 2410428

(4) Z. Peng, L. Jin, Z. Zuo, Q. Qi, S. Hou, Y. Fu, D. Zou, *ACS Appl. Mater. Interfaces*, **2023**, 15, 23518.

(5) Z. Peng, Z. Zuo, Q. Qi, S. Hou, Y. Fu, D. Zou, *ACS Appl. Energy Mater*., **2023**, 6, 7556.

(6) Z. Peng, Z. Zuo, Q. Qi, S. Hou, Y. Fu, D. Zou, *ACS Appl. Energy Mater.*, **2023**, 6, 1396.

(7) Bo Gao, Zhuang Zuo, Jing Hu, Qi Qi, Zongyang Peng, Shaocong Hou, Yongping Fu, and Dechun Zou, *ACS Materials Lett.*, **2024**, 6, 5300−5306

[IV 01-5]

Ultrafast Refractive Index Spectroscopy for Probing Photoinduced Processes in Optoelectronic Material

Kai Chen[a,b,c,#,*], Ronnie R. Tamming[b], Yu-Hui Chen[d,*], Pieter Geiregat[e], and Shang-Da Yang[f]
[a]Robinson Research Institute, Victoria University of Wellington, New Zealand
[b]MacDiarmid Institute for Advanced Materials and Nanotechnology, New Zealand
[c]The Dodd-Walls Centre for Photonic and Quantum Technologies, New Zealand
[d]School of Physics, Beijing Institute of Technology, Beijing, China
[e]Department of Chemistry, Ghent University, Ghent, Belgium
[f]Institute of Photonics Technologies, National Tsing Hua University, Taiwan
Email: kai.chen@vuw.ac.nz

Keywords: Ultrafast spectroscopy, Optoelectronic materials, Photoexcitation dynamics, Time-resolved frequency-domain interferometry. Transient Phase modulation.

The ability to monitor transient changes in the complex refractive index of materials provides powerful insights into excited-state processes that govern optoelectronic functionality. In this presentation, I will introduce the development of an ultrafast refractive index spectroscopy technique based on frequency-domain interferometry (FDI). This method, built as a model-independent extension of transient absorption spectroscopy, enables femtosecond-resolved, spectrally resolved measurements of both the real and imaginary components of the refractive index.

Our recent progress focuses on enhancing the performance of this technique through the integration of advanced ultrafast light sources and a novel FDI optical design. This approach enables us to achieve a bright and broadband probe compatible with interferometric detection. Furthermore, we have implemented a compact and phase-stable interferometer configuration that improves fringe visibility and temporal resolution, allowing reliable refractive index measurements across a wide spectral window.

Building on this technical foundation, I will present several case studies on optoelectronic materials, including perovskites and colloidal quantum materials. These examples demonstrate how ultrafast refractive index spectroscopy reveals key photoexcitation processes that are critical to the design of advanced photonic and optoelectronic devices. I will also highlight our latest findings on hybrid quantum dot–plasmonic structures, which exhibit enhanced and tunable optical responses.

This work establishes ultrafast refractive index spectroscopy as a versatile and powerful characterization tool for the development of next-generation optoelectronic materials.

[References]

(1) Tamming, R. R., Hodgkiss, J. M., & Chen, K. (**2022**). *Advances in Physics: X*, 7(1), 2065218.

(2) Tamming, R. R., et al. (**2019**). *ACS Photonics*, 6(2), 345-350.

(3) Ashoka, A., et al. (**2022**). *Nature Communications*, 13(1), 1437.

(4) Tanghe, I., Butkus, J., Chen, K., Tamming, R. R., Singh, S., Ussembayev, Y. (**2021**). *Nano Letters*, 22(1), 58-64.

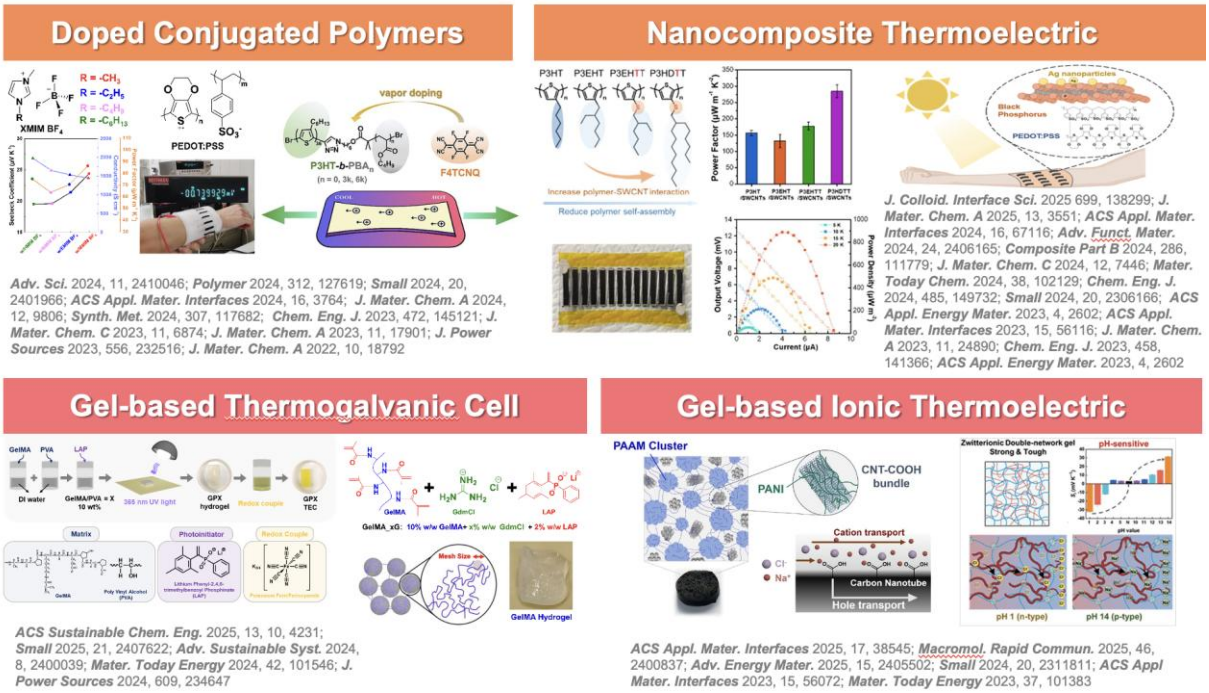
[IV 01-6]

Organic/Hybrid Thermoelectric Materials and Devices

Cheng-Liang Liu[#,*]
Department of Materials Science Engineering, National Taiwan University, Taipei 10617, Taiwan
Email: liucl@ntu.edu.tw

Keywords: organic thermoelectric, doping, conjugated polymers, nanocomposites, gel

Organic thermoelectric materials can directly transform the waste heat into electrical power without causing any pollution, but their development is limited due to poor performance, especially low conductivity. In my talk, we outline the design strategies which aim to develop high-performing organic semiconductors and their materials in organic thermoelectrics. A series of solution-processed organic semiconducting molecules are reported. These results indicate that these materials can be modulated through successive changes in conjugation length/side chain substituent length and molecular interaction based on a combination of molecular design and solution-processing techniques. Doping organic semiconductors, conjugated polymer composites, and gels with ionic salt or redox couples are used to achieve enhanced thermoelectric performance. Flexible/wearable thermoelectric generator based on these materials will be demonstrated[1-3].



Adv. Sci. 2024, 11, 2410046; *Polymer* 2024, 312, 127619; *Small* 2024, 20, 2401966; *ACS Appl. Mater. Interfaces* 2024, 16, 3764; *J. Mater. Chem. A* 2024, 12, 9806; *Synth. Met.* 2024, 307, 117682; *Chem. Eng. J.* 2023, 472, 145121; *J. Mater. Chem. C* 2023, 11, 6874; *J. Mater. Chem. A* 2023, 11, 17901; *J. Power Sources* 2023, 556, 232516; *J. Mater. Chem. A* 2022, 10, 18792

J. Colloid. Interface Sci. 2025 699, 138299; *J. Mater. Chem. A* 2025, 13, 3551; *ACS Appl. Mater. Interfaces* 2024, 16, 67116; *Adv. Funct. Mater.* 2024, 24, 2406165; *Composite Part B* 2024, 286, 111779; *J. Mater. Chem. C* 2024, 12, 7446; *Mater. Today Chem.* 2024, 38, 102129; *Chem. Eng. J.* 2024, 485, 149732; *Small* 2024, 20, 2306166; *ACS Appl. Energy Mater.* 2023, 4, 2602; *ACS Appl. Mater. Interfaces* 2023, 15, 56116; *J. Mater. Chem. A* 2023, 11, 24890; *Chem. Eng. J.* 2023, 458, 141366; *ACS Appl. Energy Mater.* 2023, 4, 2602

ACS Sustainable Chem. Eng. 2025, 13, 10, 4231; *Small* 2025, 21, 2407622; *Adv. Sustainable Syst.* 2024, 8, 2400039; *Mater. Today Energy* 2024, 42, 101546; *J. Power Sources* 2024, 609, 234647

ACS Appl. Mater. Interfaces 2025, 17, 38545; *Macromol. Rapid Commun.* 2025, 46, 2400837; *Adv. Energy Mater.* 2025, 15, 2405502; *Small* 2024, 20, 2311811; *ACS Appl Mater. Interfaces* 2023, 15, 56072; *Mater. Today Energy* 2023, 37, 101383

Fig. 1. The related work in the organic thermoelectrics from our group.

[References]

(1) J.-F. Ding, K. Yamanaka, S.-H. Hong, G.-L. Chen, W.-N. Wu, J.-M. Lin, S.-H. Tung, I. Osaka, C.-L. Liu, *Adv. Sci.*, **2024**, 48, 2410046.

(2) M.-H. Lin, M. G. Mohamed, C.-J. Lin, Y.-J. Sheng, S.-W. Kuo, C.-L. Liu, *Adv. Funct. Mater.*, **2024**, 24, 2406165

(3) S.-T. Kao, C.-C. Hsu, S.-H. Hong, U-S. Jeng, C.-H. Wang, S.-H. Tung, C.-L. Liu, *Adv. Energy Mater.*, **2025**, 15, 2405502

[IV 01-7]

AI-Assisted Study of Perovskite Solar Cells

Lixin Xiao[#,*]
Department of Physics, Peking University, Beijing, China
Beijing Huairou Laboratory, Beijing, China
Email: lxxiao@pku.edu.cn

Keywords: AI, Perovskite, Humidity, δ-FAPbI3, Solar cell

Perovskite solar cells (PSCs) based on black-phase formamidinium lead iodides (α-FAPbI3), which have an optimal bandgap of 1.5 eV, have achieved an impressive power conversion efficiency (PCE) of 26.1%. Solvent engineering has proven crucial for achieving high-quality α-FAPbI3 perovskite films. To date, most solution processing methods have used a cosolvent system containing volatile solvents such as dimethylformamide (DMF) and acetonitrile and high-boiling-point solvents such as dimethyl sulfoxide (DMSO) and N-methyl-2-pyrrolidone (NMP) that coordinate with lead iodide (PbI2). The nonvolatile solvent molecules form key intermediate complexes, such as DMSO-PbI2 and NMP-PbI2-FAI (formamidinium iodide), through Lewis acid–base interactions. These intermediates promote orderly and homogeneous crystallization that facilitates the direct conversion to α-FAPbI3 and prevents the formation of the photoinactive δ-phase. However, this process is often limited to fabrication in an inert gas or dry air atmosphere with strictly controlled relative humidity (RH). The reproducibility and stability of unsealed α-FAPbI3 PSCs under high-humidity ambient conditions (with RH >60%) remain challenging.

We introduced chlorine-containing organic molecules to form a capping layer that blocked moisture penetration while preserving DMSO-based complexes to regulate crystal growth (Fig. 1). We report power conversion efficiencies of >24.5% for perovskite solar cells fabricated across an RH range of 20 to 60%, and 23.4% at 80% RH. The unencapsulated device retained 96% of its initial performance in air (with 40 to 60% RH) after 500-hour maximum power point operation[1].

In recent years, a series of studies have demonstrated how artificial intelligence (AI) technology provides strong support for research on perovskite solar cells by addressing key challenges in materials design and performance optimization. Our team has also conducted AI-assisted optimization research: using Gaussian process regression, we determined that the optimal doping concentration of KI in $MAPbI_3$ solar cells is 3%, which increased the cell efficiency from 16.0% to 20.9%[2]. Moreover, we established a unified material descriptor system for both inorganic and organic-inorganic hybrid perovskites, and achieved high-precision prediction of the band gap, conduction band minimum, and valence band maximum energy levels of halide perovskites through machine learning methods[3]. These achievements highlight the crucial role of AI in accelerating the research and development of perovskite solar cells.

[References]

(1) Lixin Xiao et al., "A crystal capping layer for formation of black-phase FAPbI3 perovskite in humid air", *Science*, 385, 161–167 (**2024**).

(2) Jiang et al., *Rare Metals* 40, 1698–1707 (**2021**).

(3) Ye et al., *Materials Futures* 4, 035601 (**2025**).

[IV 01-8]

Engineering Stable Multi-Resonance Fluorescence Emitters for Durable Blue Organic Light Emitting Diodes

Jang Hyuk Kwon[#,*]
Organic Optoelectronic Device Lab (OODL), Dept. of Inform. Display, Kyung Hee University,
26, Kyungheedae-ro, Dongdaemun-gu, Seoul 02447, Republic of Korea
E-mail: jhkwon@khu.ac.kr

Keywords: MR-TADF, blue OLEDs, long-lifetime.

Research on multi-resonance thermally activated delayed fluorescence (MR-TADF) emitters for organic light-emitting diodes (OLEDs) addresses technical challenges and aims to achieve economic viability across a broad spectrum of colors. Nonetheless, the development of a pure blue emitter with enhanced operational stability remains a significant obstacle. A principal factor contributing to reduced lifespan is the higher energy state that induces the breakdown of weak chemical bonds under electrical stress. Most blue MR-TADF emitters incorporate sp3 hybridized nitrogen (N) atoms (exocyclic C-N bonds) within the boron-nitrogen (B-N) core, which results in lower bond dissociation energies (BDE) in the anionic states, thereby leading to diminished device longevity during continuous operation[1].

Considering this, we demonstrate stable, pure blue emitters composed of core rigidification and π-localization achieved through an asymmetric N-donor fusion strategy. This is accomplished by constructing a B-N emitting framework on a robust carbazole backbone. The strong endocyclic (sp2) C-N bonds of the carbazole, together with extended core π-conjugation, synergistically elevate the BDEs of the vulnerable C-N bonds in high-energy anionic states. Consequently, the emitter is stabilized against degradation under electronic stress. Furthermore, the peripheral carbazole units modulate the emission towards a pure blue region at 457 nm and 459 nm in toluene solution for the emitters KBD-22 and KBD-44, respectively. The increased structural rigidity results in a high PLQY exceeding 94%. The fabricated PSF-OLED exhibits high EQEs of 25.8% and 23.6%, maintaining a value of 18.0% even at a luminance of 1000 cd/m². Additionally, the fabricated fluorescence OLEDs (Fl-OLED) emit at 459 nm and 463 nm, with a narrow FWHM of ⩽30 nm, and possess corresponding CIExy coordinates of (0.13, 0.09) for KBD-22 and KBD-44. The Fl-OLED based on KBD-22 exhibits a high maximum EQE (EQEmax) of 8.67%, with minimal efficiency roll-off. Notably, the corresponding device demonstrates an extended operational lifetime (LT95) of 95 h at an initial luminance of 1000 cd/m², attributed to its high BDEs in the anionic state. This achievement represents one of the highest device lifetimes reported among Fl-OLEDs utilizing single boron MR emitters.

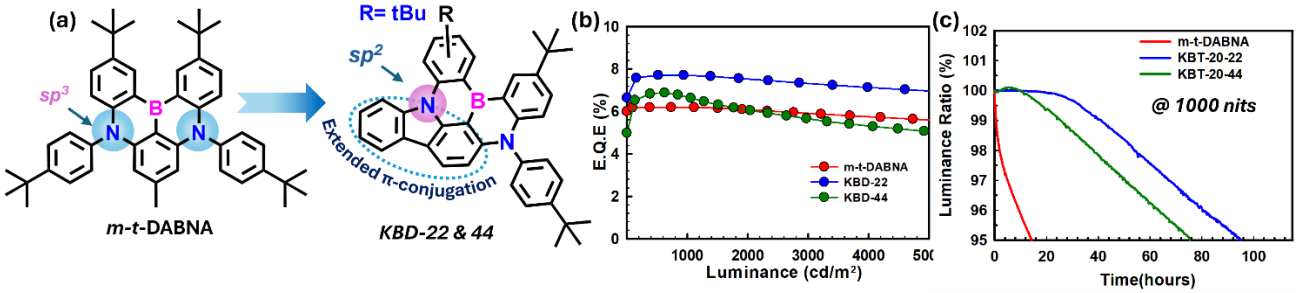


Fig. 1. (a) Molecular structure of m-t-DABNA and design concept of KBD-22 &44, (b) EQE vs L plot, and (c) Lifetime plot of Fl-OLEDs based on KBD-22&44, and m-t-DABNA.

[References]

(1) Y. Shi, H. Shi, H. Wang, C.-J. Chen, Y. Li, B. Qiao, Z. Liang, S. Zhao, D. Hang, Z. Xu, D. Song, *Chemical Engineering Journal* **2024**, 500, 157082.

[IV 01-9]

Photoactive Material Design for Intrinsically-Stretchable Polymer Solar Cells

Bumjoon Kim[#,*]
Department of Chemical and Biomolecular Engineering, KAIST, South Korea
E-mail: bumjoonkim@kaist.ac.kr

Considering the technical standards (e.g., mechanical robustness) required for wearable electronics, which are promising application platforms for organic solar cells, the development of fully stretchable OSCs (f-SOSCs) should be accelerated. First, the mechanical requirements of f-SOSCs, in terms of tensile and cohesion/adhesion properties, are summarized along with the experimental methods to evaluate those properties. Second, important studies to make each layer of f-SOSCs stretchable and efficient are discussed, emphasizing strategies to simultaneously enhance the photovoltaic and mechanical properties of the active layer. For example, I present material design strategies to enhance the mechanical robustness of the PSCs as well as their power conversion efficiencies (PCEs); i) incorporating a high-molecular weight polymer acceptor as an electro-active additive into binary blends, ii) design of hydrogen-bonding incorporated polymers, and iii) design of block copolymerized electroactive polymers. With these contributions, the f-SOSCs with over 14% PCE and excellent stretchability are developed. In addition, I will present the example of strain-induced power enhancement using these f-SOSCs.

[References]

(1) Park, J. S. et al. *Adv. Mater*. **2022**, 34, 2201623

(2) Seo, S. et al. *Adv. Mater*. **2023**, 35, 2300230

(3) Sun. C. et al. *Joule* **2023**, 7, 416

(4) Lee, J. W. et al. *Joule* **2024**, 8, 204

(5) Lee, J. W. et al. *Joule* **2025**, 9, 101792

(6) Lee, J. W. et al. *Energy Environ. Sci*. **2025**, 18, 3325

(7) Lee, J. W. et al. *Energy Environ. Sci*. **2025**, 18, 7079

[IV 01-10]

Squaraine aggregates and films: from modeling to photodetectors

Davide Giavazzi[a], Anna Painelli[#,*]
Department of Chemistry, Life Science and Environmental Sustainability, University of Parma
Parco Area delle Scienze, 17/A, 43124 Parma, Italy
Email: anna.painelli@unipr.it

Keywords: squaraine dyes, aggregates, charge-transfer interactions, photogeneration of charges, chirality.

Squaraines are a large family of molecules characterized by an intriguing photophysics. The isolated molecules show narrow intense absorption bands that can be tuned from the visible to the NIR region by chemical design. In aggregates and films, squaraine absorption spectra acquire a panchromatic character, with large peaks appearing both to the blue and to the red of the monomer absorption. An effective model for the isolated dye, proposed in our lab in 2006[1], represents the gold-standard to build models for squaraine aggregates and films.

A recent work, addressing aggregates of chiral proline-derived squaraine dyes, could not solve the on-going debate about the origin of the two peaks, due either to disorder or intermolecular charge transfer (ICT) interactions[2]. Novel data from 2D spectra of the same systems, simulated again with the same model (cf Fig. 1), finally demonstrate the ICT origin of the panchromatic spectrum.

Single component films of NIR absorbing squaraine dyes were recently exploited to build efficient photodetectors[3], but the mechanism behind the charge generation in these single component films is not clear. Here, based on our expertise on aggregates of squaraine dyes, we demonstrate that photogeneration is favoured in these systems in the amorphous phase thanks to large electrostatic disorder.

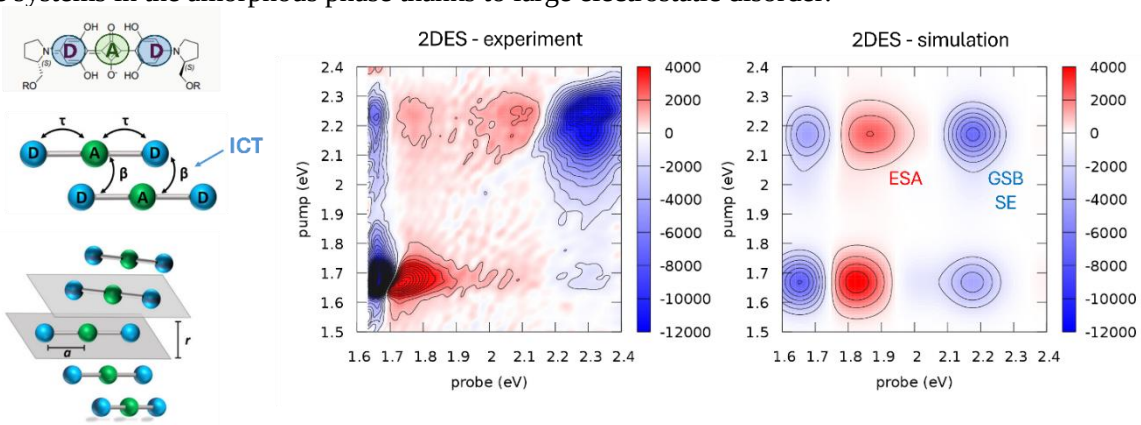


Fig. 1. Helical structure of aggregates of chiral proline-derived squaraines (left) and experimental and simulated 2DES maps of the same systems deposited by drop casting (right).

[References]

(1) F. Terenziani, A. Painelli, C. Katan, M. Charlot, M. Blanchard-Desce., *J. Am. Chem. Soc*., **2006**, 128, 15742.

(2) D. Giavazzi, F. Di Maiolo, M. F. Schumacher, L. Grisanti, J. Zablocki, A. Lützen, M. Anzola, M. Schiek, A. Painelli, *J. Mater. Chem. C*, **2023**, 11, 8307.

(3) W.-H. Hu, F. Nüesch, D. Giavazzi, M. Jafarpour, R. Hany, M. Bauer, *Adv. Optical Mater*. **2024**, 12, 2302105.

[IV 01-11]

From Ensemble to Individual: Single Perovskite Quantum Dots for Quantum Emission Applications

Hao-Wu Lin[#,*]
Department of Materials Science and Engineering, National Tsing Hua University,
Hsinchu, Taiwan,
E-mail: hwlin@mx.nthu.edu.tw

Keywords: Perovskite Quantum Dots, Quantum Emitters, Chirality, Single-Photon Emission, Emission Blinking.

Halide perovskite quantum dots (PQDs) are compelling candidates for quantum technologies, despite historical limitations in stability and blinking. This presentation will demonstrate how strategic material engineering can overcome these challenges, establishing PQDs as a robust and versatile platform for advanced quantum emission. We will first detail a novel spray-synthesis method for $CsPbI_3$ PQDs, which produces ultra-stable, high-brightness single-photon emitters with inherent self-healing capabilities, proving their viability for high-speed quantum random number generation. Building on this, our research further uncovers highly efficient, non-blinking single-photon emission from $MAPbI_3$-based QDs, a behavior directly linked to the effective suppression of biexciton formation. Complementing these advancements, we have also successfully engineered intrinsic chiral quantum emission from lattice-symmetry-broken $CsPbI_3$ PQDs, achieving an unprecedented luminescence dissymmetry factor (g_{lum}) exceeding 0.4. Collectively, these advances in synthesis and structural design showcase PQDs' capacity to overcome previous limitations, thus accelerating their scalable, room-temperature application in quantum communication, cryptography, and nanophotonics.

(1) B. W. Hsu, Y. T. Chuang, C. Y. Cheng, C. Y. Chen, Y. J. Chen, A. Brumberg, L. Yang, Y. S. Huang, R. D. Schaller, L. J. Chen, C. S. Chuu and H. W. Lin, *ACS Nano*, **2021**, 15, 11358–11368

(2) Y.-T. Chuang, T.-Y. Lin, G.-H. Tan, P.-E. Jan, H.-C. Lin, H.-M. Chen, K.-Y. Hsiao, B.-H. Chen, C.-H. Lu, C.-H. Lee, C.-W. Pao, S.-D. Yang, M.-Y. Lu, H.-W. Lin, *Small* **2024**, 20, 2308676.

(3) H.-M. Chen, C.-C. Wu, Y.-T. Chuang, et al., *Small*, **2025**, *21*, e07947.

[IV 02-1]

Application of Heavy Chalcogens in Organic Light-Emitting Materials

Mengke Li, Shi-Jian Su[#,*]
South China University of Technology, Wushan Road 381, Guangzhou 510640, P. R. China.
Email: mssjsu@scut.edu.cn

Keywords: Organic light-emitting diodes; Thermally activated delayed fluorescence; Room-temperature phosphorescence; Chalcogen elements

Heavy chalcogens (sulfur and selenium) have attracted significant attention in the design of organic light-emitting diode (OLED) materials due to their distinctive electronic properties. They not only provide moderate electron-donating ability but also effectively regulate exciton dynamics, thereby enhancing triplet exciton utilization and improving electroluminescent performance in OLED devices. Based on these advantages, through rational incorporation of heavy chalcogens to modulate emission mechanisms, a series of high-performance thermally activated delayed fluorescence (TADF) materials and purely organic room-temperature phosphorescence (RTP) materials have been developed (Figure 1). In the design of TADF materials, chalcogen-containing donors introduce heavy-atom effects and n-π* transition characteristics, which significantly promote reverse intersystem crossing thereby improving the luminescence efficiency in both donor-acceptor and multiple-resonance type TADF materials[1]. Additionally, oxidized sulfur derivatives exhibit unique weak electron-accepting properties, showing great promise as acceptors for high-efficiency blue TADF emitters[2]. The enhanced SOC also plays a critical role in enabling RTP within purely organic systems, overcoming spin-forbidden transitions and opening avenues for heavy-metal-free phosphorescent OLEDs[3]. Furthermore, by precisely modulating SOC strength through strategic incorporation of sulfur, dual emission mechanisms can be achieved within a single molecule[4]. This has advanced the development of single-molecule white-light OLEDs based on fluorescence and phosphorescence emissions.

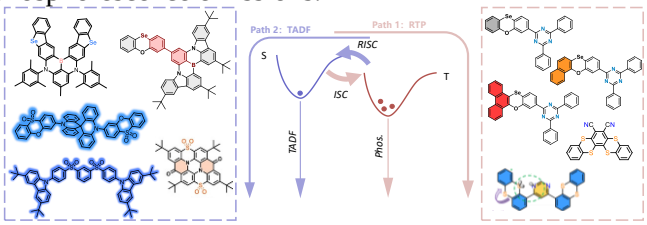


Figure 1. Heavy chalcogens-based representative TADF and RTP emitters.

[References]

(1) a) Z. Yang, et al. *Angew. Chem. Int. Ed*. **2025**, e202423602; b) Z Chen, et al. *Adv. Funct. Mater*. **2024**, 34, 2404278; c) M. Li, R Li, Z. Li, et al. *Adv. Optical Mater.* **2024,** 2402822; d) X. Cai, Z. Qiao, M. Li, et al. *Angew. Chem. Int. Ed***. 2019**, 58, 13522.

(2) a) S.Jiang, Y. Yu, D. Li, et al. *Angew. Chem. Int. Ed.* **2023**, 62, e202218892; b) S. Jiang, D.Liu, Z. Chen, et al. *Adv. Funct. Mater***. 2024**, 34, 2316355; c) G. Xie, X. Li, D. Chen, et al. *Adv. Mater*. **2016**, 28, 181–187; d) M. Liu, et al. *Ad. Optical Mater.* **2017**, 5, 1700334; e) Y. Li, et al. *Chem. Mater*. **2015**, 27, 1100-1109.

(3) a) Z.n Chen, et al. *Adv. Sci.* **2023**, 10, 2207003.; b) Z. Chen, Q.Gu, M. Li, et al. *Adv. Optical Mater*. **2024**, 12, 2302503; c) W. Qiu, X. Cai, Z. Chen, et al. *J. Phys. Chem. Lett*. **2022**, 13, 4971-4980; d) Z. Chen, Q. Gu, M. Li, et al. *Next Mater.* **2025**, 8, 100539.

(4) a) M. Li, et al. *Angew. Chem. Int. Ed.* **2025**, 64, e202420474; b) M. Li, et al. *Angew. Chem. Int. Ed.* **2022**, 61, e202209343.

[IV 02-2]

A post-processing approach to unlock mixed conduction in organic semiconductors

Yuan-Qiu-Qiang Yi, Nadege Bonnet, Christine K. Luscombe[*, #]
api-Conjugated Polymers Unit, Okinawa Institute of Science and Technology, Onna-son, Okinawa, Japan
Email: christine.lusombe@oist.jp

Keywords: Organic mixed ionic/electronic conductors, organic electrochemical transistors,

Organic mixed ionic/electronic conductors (OMIECs) are materials capable of transporting both electronic charges and ionic species simultaneously, enabling a wide range of applications such as organic electrochemical transistors (OECTs), biosensors, energy storage devices, and neuromorphic systems. Despite their potential, developing materials that can effectively balance both ionic and electronic conduction is a significant challenge. Organic semiconductors, which are traditionally optimized for electronic transport, lack the necessary structural features to also support efficient ion movement, making mixed conduction difficult to achieve.

Organic semiconductors are designed with conjugated backbones that allow for efficient electronic transport, but their hydrophobic nature and dense molecular packing hinder ion diffusion. To address this, researchers have employed several strategies to modify these materials for mixed conduction. One common approach is to functionalize the organic semiconductor with hydrophilic side chains, such as ethylene glycol or sulfonates, which introduce pathways for ion transport. These side chains can absorb moisture or electrolytes, facilitating ion movement through the material. However, this approach often disrupts the π-conjugated structure responsible for electronic transport, leading to a trade-off between ionic and electronic mobility.

The challenge of achieving high-performance OMIECs lies in the need to balance these two transport mechanisms—ensuring that enhancements in ionic conduction do not come at the expense of electronic mobility. This makes the design and synthesis of new materials a difficult and time-consuming endeavor, particularly when scaling up for practical applications.

In response to these challenges, we are developing a novel method to convert any organic semiconductor into a mixed ionic/electronic conductor. Instead of relying on traditional chemical functionalization or blending techniques, our approach involves a post-processing treatment that can be applied to a wide range of organic semiconductors.

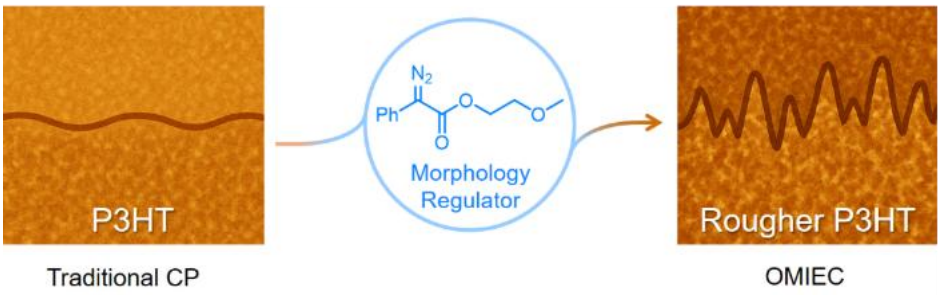


Fig. 1. Illustration of molecule-mediated formation of OMIECs through morphology regulation.

[IV 02-3]

3,6-Bis(methylthio)-9H-carbazole Based Self-Assembled Monolayer for Highly Efficient and Stable Inverted Perovskite Solar Cells

Shahid Ameen[a], BongSoo Kim[a,#,*]
[a]Department of Chemistry, Ulsan National Institute of Science and Technology (UNIST), UNIST-gil 50, Ulsan 44919, Republic of Korea.
Email: bongsoo@unist.ac.kr

Keywords: self-assembled monolayers, hole injection layers, interfacial passivation, inverted perovskite solar cells**.**

The photovoltaic performance of inverted perovskite solar cells (PSCs) relies on effectively managing the interface between the hole extraction layer and the light-absorbing perovskite layer. In this study, we have synthesised (4-(3,6-bis(methylthio)-9H-carbazol-9-yl)butyl)phosphonic acid (MeS-4PACz), which forms a self-assembled monolayer (SAM) on the fluorine-doped tin oxide (FTO) electrode. The molecule‘s methylthio substituents generate a favourable interfacial dipole moment and interact with the perovskite layer. This interaction results in well-aligned energy levels among the FTO/SAM/perovskite layers, promoting efficient hole extraction and significantly reducing carrier recombination losses. Additionally, the methylthio groups passivate iodide vacancies and interact with Pb2+ ions of the perovskite, reducing defect-induced trap states and enhancing the crystalline growth of the perovskite layer. Consequently, inverted PSCs incorporating MeS-4PACz achieve a power conversion efficiency of 25.13%, along with outstanding photostability.

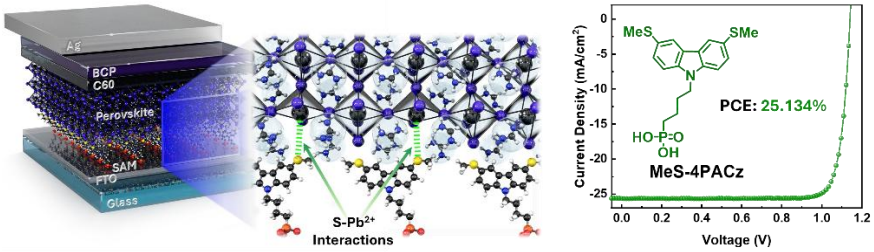


Fig. 1. Inverted perovskite solar cells using MeS-4PACz SAM.

[IV 02-4]

Charge separation and recombination interfaces in organic solar cells

James Durrant[#,*]
Centre for Processable Electronics and Department of Chemistry, Imperial College London
& Dept of Chemistry, University of Oxford, United Kingdom
Email: james.durrant@chem.ax.ac.uk

Keywords: Organic solar cells, charge separation, charge recombination, interface

The development of non-fullerene acceptors has led to substantive recent advances in the performance of organic solar cells. Such devices are typically based on organic donor / acceptor heterojunctions. The donor / acceptor is widely understood to be the key interface for both exciton / charge separation and charge recombination in such devices, with the energetic offsets at this interface being key determinants of device energetics. In my talk, I will address the role of not only this heterojunction interface but also homojunction interfaces in polymer / NFA solar cells, as well as evidence that for high performance, low energy offset devices, the dominant charge recombination is not interface limited but rather determined by recombination within the bulk of acceptor domains.

I will start by focusing on charge separation at donor / acceptor interfaces in polymer / NFA blends, addressing the activationless nature of this charge separation, independent of energetic offset. These data provide further support for the adiabatic nature of charge separation at this interface, driven by wavefunction delocalization. (1) I will go onto discuss the role of interfaces between pure, crystalline domains and molecularly mixed, more amorphous domains in stabilizing charge separation, in particular on the impact of Y6 aggregation upon its LUMO level, and the importance of this homojunction in suppressing charge recombination. (2) I will then go on to highlight the role of molecular quadrapole and octupole moments in driving or stabilizing charge separation both at donor / acceptor heterojunctions and at homojunctions in single component films. (3,4) Finally I will address non-geminate recombination losses in high performance polymer / Y6 based devices, and provide evidence the kinetics of this recombination are independent of donor / acceptor interface area or energetics. I will then present a model to explain these observations where charge recombination is no longer dominated by interfacial charge transfer states, but rather by hole injection into the acceptor followed by electron / hole recombination within acceptor domains. This conclusion suggests that strategies to minimize recombination losses in such high performance devices should not focus on the donor / acceptor interface, but rather NFA singlet and triplet exciton decay dynamics. I will conclude by discussing lessons which can be learnt about material and device optimization for high performance organic solar cells.

[References]

(1) Y. Dong, R. Zheng, D. Qian, T. H. Lee, H. L. Bristow, P. Shakya Tuladhar, H. Cha and J. R. Durrant, *J. Am. Chem. Soc*., **2024**, 146, 33579–33586

(2) S.Y. Jeong, A. Rana, W. Xu, K. Ai, R.C. Kilbride, Y. Wang, D.M. Lee, P.S. Tuladhar, H.J. Cha, J.R. Durrant *Adv. Energy Mate*r., 10 (**2025**), 2501633

(3) A. Rana, S. Y. Park, C. Labanti, F. Fang, S. Yun, Y. Dong, E. J. Yang, D. Nodari, N. Gasparini, J. Park, J. Shin, D. Minami, K.-B. Park, J.-S. Kim, J. R. Durrant, *Nat. Commun.* **2024,** 15, 5058.

(4) Y. Fu, T. H. Lee, Y.-C. Chin, R. A. Pacalaj, C. Labanti, S. Y. Park, Y. Dong, H. W. Cho, J. Y. Kim, D. Minami, J. R. Durrant, J.-S. Kim, *Nat. Commun*. **2023**, 14, 1870.

[IV 02-5]

Material Design for Synaptic Transistors: From Conjugated Polymers to Two-Dimensional Perovskites

Chu-Chen Chueh[#,*]
Department of Chemical Engineering, National Taiwan University, Taipei 10617, Taiwan
Email: cchueh@ntu.edu.tw

Keywords: Synaptic transistors, solid-state electrolyte, conjugated polymers, 2D perovskites.

Our research group focuses on the development of functional polymers and hybrid perovskites in various optoelectronic devices, including thin-film transistor (TFT), (photo-)memory, light-emitting diode (LED), and solar cell devices. We particularly focus on the relationship between the structure and properties of polymers and perovskites. In addition to advances in the controlled synthesis of these solution-processable semiconductors, we also explore innovative interface and device engineering to optimize device performance. In this presentation, we will share our recent works on the design of conjugated polymers and Sn-based 2D perovskites for transistor memories, and extend this to synaptic transistors. We will first discuss the design of organic materials for dielectric and active layers to realize organic synaptic transistors, followed by their device applications and optimization. Finally, we will highlight the potential of 2D Sn-based perovskites in memory and synaptic applications.

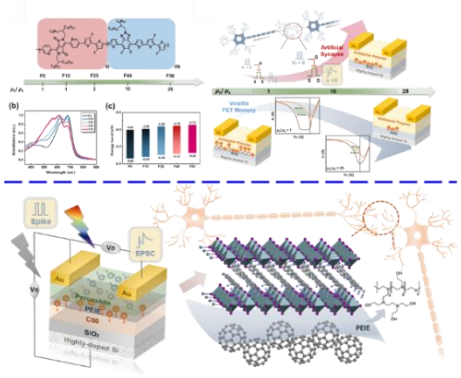


Fig. 1. Recent results from Chueh group on synaptic transistors.

[References]

(1) Hou, S.; Khatoniar, M.; Ding, K.; Qu, Y.; Napolov, A.; Menon, V. M.; Forrest, S. R. Ultralong-range energy transport in a disordered organic semiconductor at room temperature via coherent exciton-polariton propagation. *Adv. Mater.* **2020**, *32*, 2002127,

(2) Y. T. Yang, Y. H. Shih, Q. G. Chen, C. H. Chen, M. H. Yu, C. H. Nieh, B. H. Lin, W. C. Chen, W. Y. Lee, C. C. Chueh, *ACS Energy Lett.* **2024**, 9, 4564.

(3) I. H. Chao, Y. T. Yang, M. H. Yu, C. H. Chen, C. H. Liao, B. H. Lin, I. C. Ni, W. C. Chen, A. W. Y. Ho-Baillie, C. C. Chueh*, *Small*, **2023**, 19, 2207734.

(4) Y. T. Yang, Y. S. Wu, W. He, H. C. Tien, W. C. Yang, T. Michinobu, W. C. Chen, W. Y. Lee*, C. C. Chueh*, *Adv. Sci*. **2022**, 9, 2203025.

(5) T. F. Yu, H. Y. Chen, M. Y. Liao, T. T. Chang, C. C. Chueh*, W. Y. Lee*, *ACS Appl. Mater. Interfaces*. **2020**, 12, 33968-33978.

[IV 02-6]

Controlling light-matter interactions for efficient organic and hybrid optoelectronics

Shaocong Hou[#,*]
School of Electrical Engineering and Automation, Wuhan University, Wuhan, China
Email: sc.hou@whu.edu.cn

Keywords: organic semiconductors, perovskite LEDs, exciton-polaritons, machine learning, optoelectronic devices.

Organic optoelectronic materials, with their unique advantages such as tunable properties and solution processing, have opened up new avenues for the development of next-generation optoelectronic devices. In the field of organic semiconductors, we have gained a deep understanding of dipole orientation in thin films and achieved ultrastrong all-dielectric coupling between Frenkel excitons and Bloch surface waves at room temperature. This enables polaritons to propagate over 100 microns at a group velocity of 3×10^7 m/s. This has led to the development of polariton optoelectronic devices with an external quantum efficiency of 2% at a distance of 200 microns.

Leveraging a synergistic "materials-photonics" strategy, we developed a rapid organic vapor deposition technique and designed a LiF/SiN_x dual resonant cavity, achieving both narrow green emission (full width at half maximum <10 nm) and long lifetime (LT_{95} >50,000 hours) in top-emitting OLEDs, with a current efficiency of 163.6 cd/A. This strategy was further extended to perovskite systems, using trimethylaluminum vapor crosslinking and manganese doping to improve device stability and enable blue/white LEDs, respectively. An innovative copolymer micelle template method significantly enhanced the stability of nanocrystals. Furthermore, machine learning was used to efficiently screen ultra-low-threshold organic gain materials, providing a new material platform for electrically pumped organic lasers.

These achievements collectively reveal the enormous potential of organic and perovskite materials, polariton physics, and AI-assisted material development in improving the performance of optoelectronic devices.

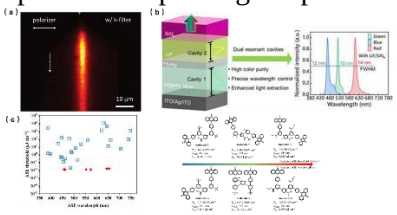


Fig. 1. (a) Long-range transmission of polaritons; (b) Dual-cavity OLED structure achieves narrowed spectrum and long lifetime; (c) Machine learning-assisted new material discovery.

[References]

(1) S. Hou, M. Khatoniar, K. Ding, Y.Qu, Alexander Napolov, Vinod M. Menon, Stephen R. Forrest. *Adv. Mater*., 2020, 32, 2002127.

(2) J. Kim, H. Zhao, S. Hou, M. Khatoniar, V. Menon, S. R. Forrest, *Phys. Rev. Appl.* **2020**, 14, 034048.

(3) J. Kim, S. Hou, H. Zhao, S. R. Forrest, *Nano Lett.* **2020**, 20, 8290.

(4) Liu, B., Huang, X., Hou, S., Fan, D. & Forrest, S. R. *Optica* 9, 1029–1036 (**2022**)

(5) , S. Hou, S. R. Forrest et al. *Phys. Rev. B*, **2019**, 4, 100

[IV 02-7]

Tetrabenzoporphyrins for High-Performance Single-Crystal Organic Field-Effect Transistors

Hiroko Yamada[#,*]
Institute for Chemical Research, Kyoto University, Gokasho, Uji, Kyoto 630-0011, Japan.
Email: hyamada@scl.kyoto-u.ac.jp

Keywords: tetrabenzorporphyrin, organic field-effect transistors, single crystals, substituent effect

Organic electronic materials are pivotal for developing next-generation flexible and lightweight devices. This talk will critically discuss about tetrabenzoporphyrins (BPs) as highly promising organic semiconductors for organic field-effect transistors (OFETs), emphasizing how peripheral substituents influence charge transport properties. By elucidating the effects of substituent size, shape, and placement on molecular aggregation, this work provides comprehensive insights into BP-based OFETs. Strategic derivatization is shown to modulate intermolecular CH–π and π–π interactions, leading to diverse packing motifs like one-dimensional slip-stacked, brickwork, herringbone, and layered structures (Figure a and b) [1-3]. These varied molecular arrangements critically influence carrier mobility and device performance. Experimental results, particularly single-crystal X-ray diffraction analyses and OFET characterizations, corroborate the significance of molecular packing in optimizing device performance. Ultimately, understanding these structure-function correlations offers valuable guidelines for the rational design of high-mobility, thermally robust organic semiconductors, paving the way for innovative applications in flexible electronics and advanced device architectures. This critical analysis provides strategic directions for future research and development, advancing the field of organic electronics.

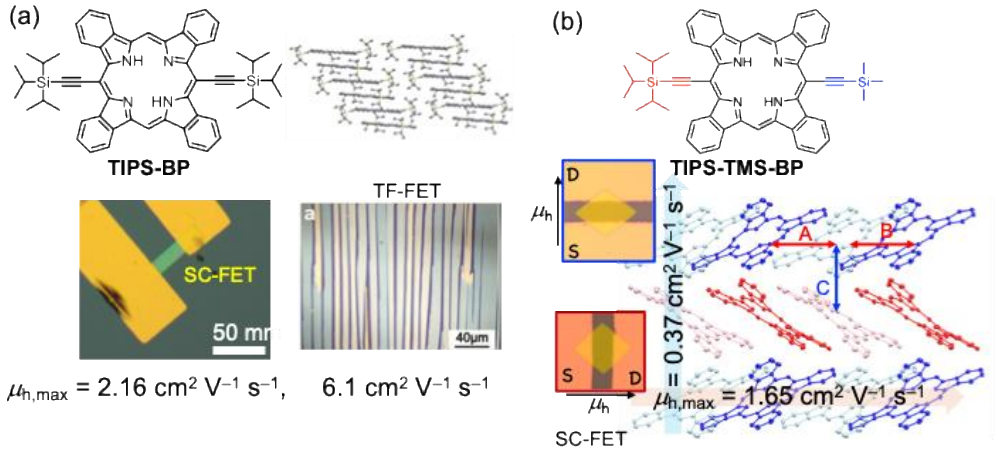


Fig. 1. Bottom-gate-top-contact OFETs of (a) TIPS-BP and (b) TIPS-TMS-BP.

[References]

(1) J. Zhu, H. Hayashi, M. Chen, C. Xiao, K. Matsuo, N. Aratani, L. Zhang and H. Yamada, , *J. Mater. Chem. C*, **2022**, 10, 2527

(2) G. Xue, B. Peng, T. Ye, J. Wu, Y. Zhao, Y. Liu, H. Yamada, H. Chen, H. Li, Adv. Electron. Mater. 2022, 8, 2200158

(3) K. Miyazaki, K. Yamamoto, M. Yamauchi, Y. Mizuhata, H. Matsuda, N. Shioya, T. Hasegawa, N. Aratani, H. Yamada, J. Porphyr. Phthalocyanines 2025, 29, 213–220.

[IV 02-8]

Understanding Polaron Formation and Transport in Organic Electrochemical Devices

Ji-Seon Kim[#,*]
Department of Chemistry, University of Oxford
E-mail: ji-seon.kim@chem.ox.ac.uk

Polarons exist when charges are injected into organic semiconductors due to their strong coupling with the lattice phonons (electron-phonon coupling), significantly affecting charge transport properties. Understanding the formation/deformation and localization/delocalization of polarons induced by ions is critical for development of organic electrochemical devices such as organic electrochemical transistors (OECTs) and organic synaptic transistors (OSTs). However, there have been only few studies reported in this area, lacking direct evidence on in situ polaron formation/deformation and associated structural changes. In this talk, I will show our recent work in this area. First, how a minor modification of side chains (alky, glycol and density) in conjugated polymers affects the polaron formation via electrochemical doping. Second, how elongated conjugated backbone impacts polaron formation and transport. Finally, I will show molecular structure dependent ion retention by tracking polaron-induced structural changes during a gate-voltage pulse operation. These results provide key experimental evidence and fundamental understanding of the strong electron-phonon coupling in molecular semiconductors and its impact on organic electrochemical devices.

[References]

(1) K. Stewart et al., “Understanding Effects of Alkyl Side Chain Density on Polaron Formation via Electrochemical Doping in Thiophene Polymers”, *Advanced Materials* (**2023**)

(2)Tan, E. Et al., “The Role of Long-Alkyl-Group Spacers in Glycolated Copolymers for High-Performance Organic Electrochemical Transistors”. *Advanced Materials*, 34(27), (**2022**)

[IV 02-9]

A Semiconductor-Sensitized Thermal Cell Inspired by Dye-Sensitized Solar Cells

Sachiko Matsushita[a, b,#,*]
[a]J2-48, Science Tokyo 4259 Nagatsuda-cho, Midori-ku, Yokohama 226-8503, JAPAN
[b]INDEST 3F, Institute of Science Tokyo, Shibaura 3-3-6, Minato-ku, Tokyo 108-0023, JAPAN
Email: matsushita.s.0912@m.isct.ac.jp

Keywords: polymer electrolyte, renewable energy, thermal energy conversion, redox reaction, energy harvesting

The dominant approach for converting heat into electricity has been Seebeck-type thermoelectrics, where a temperature gradient across a material generates an electromotive force. In recent years, novel heat-to-electricity conversion technologies have been emerging, such as thermally rechargeable batteries that utilize temporal temperature differences[1], and organic molecular thermoelectric systems based on charge separation at organic donor/acceptor interfaces[2]. In this context, we propose and investigate a new concept of semiconductor-sensitized thermal cell (STC)[3], in which thermally excited charges in semiconductors drive redox reactions of electrolyte ions to produce electricity. The proposed STC is inspired by the operating principle of dye-sensitized solar cells (DSSCs).

In a DSSC, photoexcited electrons in the dye are transferred to the electron transport layer and then to the counter electrode, where they reduce electrolyte ions. The remained hole in the dye subsequently oxidized the reduced electrolyte ion, resulting in a continuous electron circulation that produces an electric current. Inspired by these systems, we propose an STC in which thermal excitation of the semiconductor replaces dye photoexcitation. In this scheme, thermally excited electrons circulate between the working electrode, counter electrode, and electrolyte in an analogous manner, thereby enabling heat-to-electricity conversion (Figure 1).

The operating principle of the STC was demonstrated using sensitized cells fabricated with organic perovskite semiconductors and silver sulfide semiconductors, which generated electricity from both light and heat. Furthermore, it was shown that the STC reaches equilibrium and ceases discharging after continuous operation for an extended period. However, when the circuit is switched off and left to rest, the cell can discharge again, indicating that as long as heat is supplied, continuous power generation can be achieved by repeatedly switching the circuit on and off.

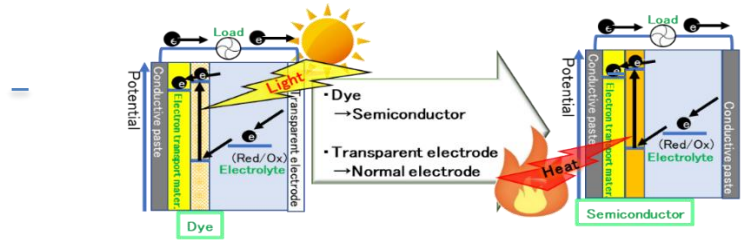


Figure 1. Schematic image of a dye-sensitized solar cell and a semiconductor-sensitized thermal cell.

[References]

(1) I. Nagai, Y. Shimaura, T. Shibata and Y. Moritomo, *Applied Physics Express*, **2021**, *14*, 094004.

(2) S. Kondo, M. Kameyama, K. Imaoka, Y. Shimoi, F. Mathevet, T. Fujihara, H. Goto, H. Nakanotani, M. Yahiro and C. Adachi, Nat. Commun., **2024**, *15*, 8115.

(3) S. Matsushita, A. Tsuruoka, E. Kobayashi, T. Isobe and A. Nakajima, Mater. Horiz., **2017**, *4*, 649–656.

(4) S. Matsushita, S. Sugawara, T. Isobe and A. Nakajima, ACS Appl. Energy Mater., **2019**, *2*, 13-18.

[IV 02-10]

Atomic Layer Deposition-Free Tin Oxide as an Electron Transport Layer for Wide-Bandgap Perovskite Solar Cells and Si/Perovskite Tandem Solar Cells

Wajidullaha, Abhishek Kumara, and Chih-Wei Chu[a,b,#,*]
[a]Research Center for Critical Issues, Academia Sinica, Tainan City 711010, Taiwan
[b]Research Center for Applied Sciences Academia Sinica, Taipei 11529, Taiwan ROC.
E-mail: gchu@gate.sinica.edu.tw

Keywords: Wide bandgap Perovskite, Spray Coating, Tin Oxide, Power Conversion Efficiency, tandem solar cells, electron transport layer, atomic layer deposition

The electron transport layer (ETL) plays a crucial role in determining the performance and stability of perovskite solar cells (PSCs). Among various ETL materials, tin oxide (SnO_2) has garnered significant attention for its excellent electronic and optical properties, including favorable energy level alignment with perovskite absorbers, high electron mobility, broad optical transparency in the visible spectrum, superior chemical stability, and minimal photocatalytic activity. However, when employed as the ETL in Si/perovskite tandem solar cells, SnO_2 is typically deposited via atomic layer deposition (ALD), an expensive and time-consuming process that hinders large-scale manufacturing. In this work, we demonstrate a cost-effective approach for fabricating SnO_2 ETLs using spray-coated ground SnO_2 nanoparticles (G-SnO_2) mixed with Cs_2CO_3. Wide-bandgap perovskite solar cells incorporating G-SnO_2 and Cs_2CO_3-G-SnO_2 as ETLs achieve power conversion efficiencies (PCEs) of 18.27% and 19.77%, respectively, with an open-circuit voltage (Voc) of 1.15 V, short-circuit current density (Jsc) of 20.47 and 21.89 mA/cm², and fill factors (FFs) of 78.5% and 79.2%. In comparison, the reference PSC exhibits a PCE of 17.46% with a Voc of 1.13 V, Jsc of 19.59 mA/cm², and an FF of 79.5%. Furthermore, Si/perovskite tandem solar cells employing spray-coated G-SnO_2 as the ETL achieve a PCE of 27.3%, with a Voc of 1.75 V, Jsc of 20.66 mA/cm², and an FF of 75.5%. These results demonstrate a promising, low-cost alternative to ALD-based SnO_2 ETLs for achieving high-performance and stable perovskite and Si/perovskite tandem solar cells, paving the way for scalable photovoltaic manufacturing.

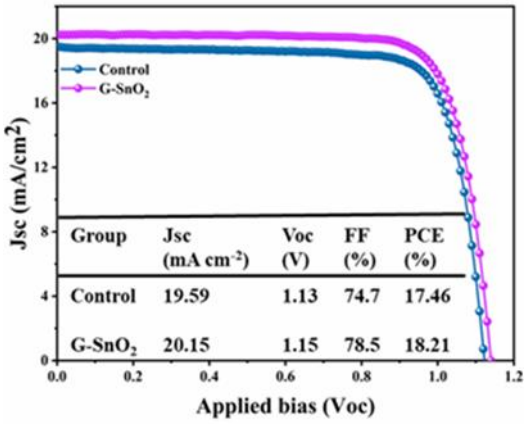


Fig. 1 J-V curve of the single junction WBG perovskite solar cell using BCP and spray coating G-SnO2.

[IV 02-11]

Influences of spontaneous orientation polarization on device performance in organic light-emitting diodes

Yutaka Noguchi[#,*]
School of Science and Technology, Meiji University, 1-1-1 Higashimita, Tama-ku, Kawasaki 214-8571, Japan.
Email: noguchi@meiji.ac.jp

Keywords: organic light-emitting diode, spontaneous orientation polarization, charge accumulation, exciton-polaron quenching.

Spontaneous orientation polarization (SOP) is an intrinsic feature of evaporated films of many common organic light-emitting diode (OLED) materials[1,2]. The polarization charges associated with SOP appear at the interfaces of the multilayer OLED structure and strongly affect charge accumulation. SOP-induced charge accumulation in the emission layer (EML) can trigger exciton–polaron quenching (EPQ), which reduces the quantum efficiency of typical Ir-complex-based OLEDs by ~20% and in turn accelerates device degradation[3-5]. Thus, both device design and property analysis that explicitly account for SOP are essential for improving OLED performance.

In this talk, I will present our studies on the influences of SOP in OLEDs, investigated by displacement current measurement (DCM) combined with photoluminescence (PL) detection (the DCM-PL technique)[6-9]. DCM-PL provides a powerful tool to study charge-carrier behavior and its correlation with exciton dynamics, such as EPQ6. As a means of controlling SOP, I will introduce “dipolar doping,” which enables significant SOP even in otherwise nonpolar films. Applied to intrinsically nonpolar hole transport layers (HTLs)7,8, dipolar doping compensates for the interfacial polarization charge originating from the EML at the HTL/EML interface, thereby improving the luminous efficiency. Finally, I will discuss the role of SOP in Ir-complex-based EMLs, focusing on its impact on the charge-accumulation zone9. We have shown that the position of the charge-accumulation zone can shift depending on the SOP of the EML. Notably, strong SOP can suppress EPQ by expelling charges from the EML, provided that the energy barrier between the emitter and the HTL is sufficiently low.

[References]

(1) Y. Noguchi, W. Brütting, H. Ishii, Jpn. *J. Appl. Phys.* **2019**, 58, SF0801.

(2) Y. Noguchi, Y. Tanaka, H. Ishii, W. Brütting, *Synth. Met.* **2022**, 288, 117101.

(3) J. S. Bangsund, J. R. Van Sambeek, N. M. Concannon, R. J. Holmes, *Sci. Adv.* **2020**, 6, eabb2659.

(4) E. Pakhomenko, S. He, R. J. Holmes, *Chem. Phys. Rev.* **2023**, 4, 021308.

(5) E. O. Afolayan, I. Dursun, C. Lang, E. Pakhomenko, M. Kondakova, M. Boroson, M. Hickner, R. J. Holmes, N. C. Giebink, *Phys. Rev. Appl.* **2022**, 17, L051002.

(6) Y. Noguchi, K. Ninomiya, K. Sato, *J. Phys. Chem. C* **2022**, 126, 18520.

(7) Y. Noguchi, A. Hofmann, W. Brütting, *Adv. Opt. Mater.* **2022**, 10, 2201278.

(8) M. Takeda, A. Hofmann, W. Brütting, Y. Noguchi, *Adv. Electron. Mater.* **2025**, 11, 2400788.

(9) S. Nakano, Y. Noguchi, *ACS Appl. Electron. Mater.* **2025**, 7, 4182-4190.

[IV 03-1]

Broadband Multiple-Plate Continuum Light Source for Ultrafast Transient Absorption Studies of Organic Upconversion Devices

Bo-Han Chen[a,#,*], Chun-Jen Shih[b,d], Chao-Yang Lin[c], Kai Chen[c], Chih-Hsuan Lu[a], Shang-Da Yang[a], Jiun-Haw Lee[b], and Shun-Wei Liu[d]
[a]Institute of Photonics Technologies, National Tsing Hua University, Hsinchu 300044, Taiwan
[b]Graduate Institute of Photonics and Optoelectronics and Department of Electrical Engineering, National Taiwan University Taipei 10617, Taiwan
[c]Robinson Research Institute, Faculty of Engineering, Victoria University of Wellington, Wellington 6012, New Zealand
[d]Organic Electronics Research Center and Department of Electronic Engineering, Ming Chi University of Technology, New Taipei City 24301, Taiwan
Email: bohan.chen@ee.nthu.edu.tw

Keywords: Multiple-plate continuum, Ultrafast transient absorption, Organic upconversion devices

The ability to probe ultrafast carrier dynamics is essential for advancing organic photoelectronics, where charge generation, separation, and recombination processes occur on femtosecond to nanosecond timescales. In this presentation, I will introduce our development of a multiple-plate continuum (MPC) light source[1] and its integration into a broadband transient absorption (TA) spectroscopy system, forming a powerful platform for investigating organic photodetectors (OPDs) and organic upconversion devices (OUDs)[2].

We have demonstrated that the MPC scheme, based on nonlinear Kerr effect through a sequence of thin glass plates, produces bright, stable, and octave-spanning white-light continua extending from the visible to near-infrared region. When combined with careful pulse compression, this source provides excellent temporal resolution and spectral coverage ideally suited for ultrafast pump-probe spectroscopy. Compared with conventional bulk or photonic crystal fiber-based continua, the MPC delivers higher spectral density, enhancing the detection signal-to-noise ratio in broadband ultrafast spectroscopy.

By employing this light source to a home-made TA setup, we were able to study the fundamental processes governing OUD performance. The measurements revealed efficient exciton dissociation, field-assisted charge separation, and prolonged carrier lifetimes under bias. These phenomena provide direct spectroscopic evidence for the strong responsivity of OPDs and the high photon-to-photon upconversion efficiency of OUDs.

In summary, I will present how the combination of bright MPC-based ultrashort pulses with TA spectroscopy creates new opportunities for studying organic photoelectronic materials and devices. This synergy not only clarifies the mechanisms underpinning current device performance but also establishes a framework for guiding the design of next-generation infrared detection and upconversion technologies.

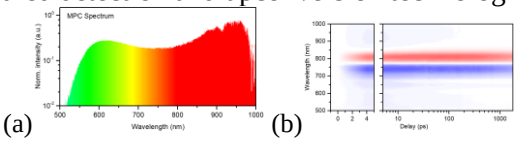


Fig. 1. (a) The spectrum of multiple-plate continuum. (b) The measured transient absorption result of OPD.

[References]

(1) B. Chen, J. Su, J.-Y. Guo, K. Chen, S.-W. Chu, H.-H. Lu, C.-H. Lu, S.-D. Yang, *Front. Photonics* 2022, 3, 937622.

(2) C.-J. Shih, C.-Y. Lin, K. Chen, N. R. A. Amin, D. Luo, I. Hsu, A. K. Akbar, S. Biring, C.-H. Lu, B.-H. Chen, S.-D. Yang, J.-H. Lee, S.-W. Liu, *Adv. Sci.* **2023**, 10, 2302631

[IV 03-2]

Multiresonance-Donor-Multiresonance Emitter for Efficient Narrowband Blue OLEDs

Jianxin Tang[#,*]
Macao Institute of Materials Science and Engineering (MIMSE), Macau University of Science and Technology, Taipa 999078, Macao, P. R. China.
Email: jxtang@must.edu.mo

Keywords: Solution-processed OLEDs, narrowband emissoin, high efficiency, MR-TADF, hybrid short/long-range charge-transfer

Solution processing has emerged as an up-and-coming technique for the scalable manufacture of organic light-emitting diodes (OLEDs), owing to the material saving and compatibility with large-area manufacturing. Nonetheless, the development of solution-processable pure blue emitters that exhibit optimal color purity and electroluminescent efficiency presents a significant challenge in pursuing high-performance solution-processed devices. Herein, we demonstrate a molecular configuration strategy to create solution-processable multiresonance thermally activated delayed fluorescence (MR-TADF) emitters. The methodology encompasses the construction of a "Multiresonance-Donor-Multiresonance (MR-D-MR)" framework that features hybrid short/long-range charge-transfer excitation characteristics. The proof-of-concept emitter demonstrates considerable rigidity and reduced vibronic progression, resulting in pure blue narrowband emission at 474 nm. Furthermore, it possesses a large oscillator strength and significant spin-orbit couplings, facilitating rapid exciton dynamics. These advantageous properties enable the emitter to achieve a record-high electroluminescent efficiency of 35.1% for sensitizer-free solution-processed OLEDs.

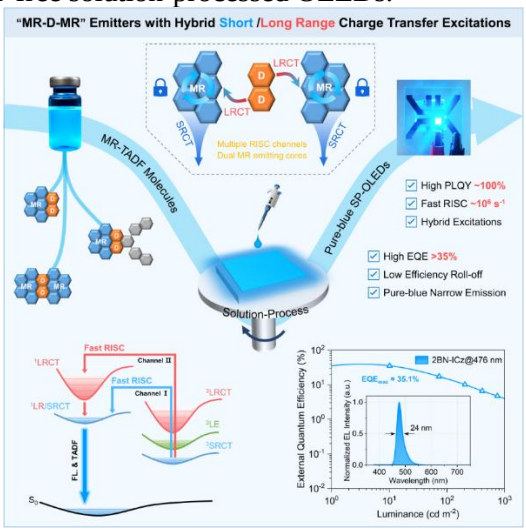


Fig. 1. Schematic illustration of MR-TADF molecular design strategy.

[References]

(1) Y.H. He, J.Y. Liu, Z. Zhang, G.W. Chen, Y.C. Wang, G. Yuan, F.M. Xie, J.X. Tang, Y.Q. Li, *Matter* **2025**, 8, 102188.

(2) H.-N. Shi, F.-M. Xie, H.-Z. Li, J.-X. Tang, Y.-Q. Li, *Adv. Funct. Mater.* **2024**, 2413579.

[IV 03-3]

Inverted Region of Reverse Intersystem Crossing in Inverted Singlet–Triplet Materials

Naoya Aizawa[a,b, #,*]
[a] Division of Applied Chemistry, Graduate School of Engineering, the University of Osaka, 2-1 Yamadaoka, Suita, Osaka 565-0871, Japan
[b]Institute for Chemical Reaction Design and Discovery (WPI-ICReDD), Hokkaido University, Sapporo, Hokkaido 001-0021, Japan
Email: aizawa@chem.eng.osaka-u.ac.jp

Keywords: singlet–triplet inversion, delayed fluorescence, inverted region, RISC, OLEDs

Organic molecules exhibiting delayed fluorescence are promising luminescent materials for organic light-emitting diodes (OLEDs). Shorter delayed fluorescence lifetimes can be achieved by energy inversion of the first singlet and triplet excited states (S1 and T1), which promote reverse intersystem crossing (RISC) from the higher-lying T1 to the lower-lying S1.1 However, optimal singlet–triplet energy gap (ΔEST) for fast RISC remains unexplored. In this study, we investigate the excited-state dynamics of heptazine derivatives with different negative ΔEST values (Fig. 1). The rate constants of RISC exhibit an inverted dependence on negative ΔEST, which can be explained by the Marcus-type non-adiabatic transition model2,3. This finding suggests that RISC becomes barrierless when –ΔEST and the reorganization energy are equal, providing an important guideline for future material development.

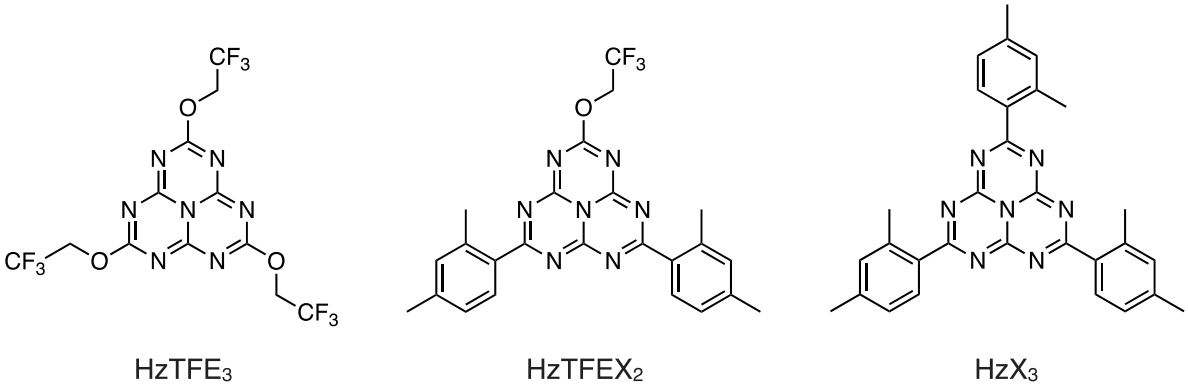


Fig. 1. Molecular structures of HzTFE3, HzTFEX2, and HzX3.

[References]

(1) N. Aizawa, Y.-J. Pu, Y. Harabuchi, A. Nihonyanagi, R. Ibuka, H. Inuzuka, B. Dhara, Y. Koyama, K. Nakayama, S. Maeda, F. Araoka, D. Miyajima, *Nature* **2022,** 609, 502.

(2) Blumberger, J. R, *Chem. Rev*. **2015**, 115, 11191.

(3) N. Aizawa, Y. Harabuchi, S. Maeda, Y.-J. Pu, *Nat Commun*. **2020**, 11, 3909.

[IV 03-4]

Organic Free-form Electronics for Wearable Displays and Sensors

Seunghyup Yoo[#,*]
School of Electrical Engineering, Graduate School of Semiconductor Technology, Korea Advanced Institute of Science and Technology (KAIST),
Daejeon, 34141, Republic of Korea

Keywords: stretchable OLEDs, ultrathin OLEDs, CO2 sensors, pulse oximetry sensors, Outcoupling

Low-temperature processability of organic electronics allows for electronic and optoelectronic devices having various form factors, opening up a venue toward free-form optoelectronic devices such as highly flexible and/or stretchable displays. In addition, they can also be beneficial for wearable or body-attachable devices, sensing physiological signals or performing phototherapeutic treatment. In this talk, we present ultrathin organic optoelectronic technologies and how they can be used to create highly efficient yet stretchable displays with high geometrical fill factors. Stretchable OLEDs based on hidden active areas and those based on 3D pop-up architectures will be presented. Furthermore, biomedical applications of ultrathin OLEDs are introduced, including OLED contact lenses for electroretinography (ERG) and catheters for internal photobiomodulation. (See Figure 1.)[1-4]

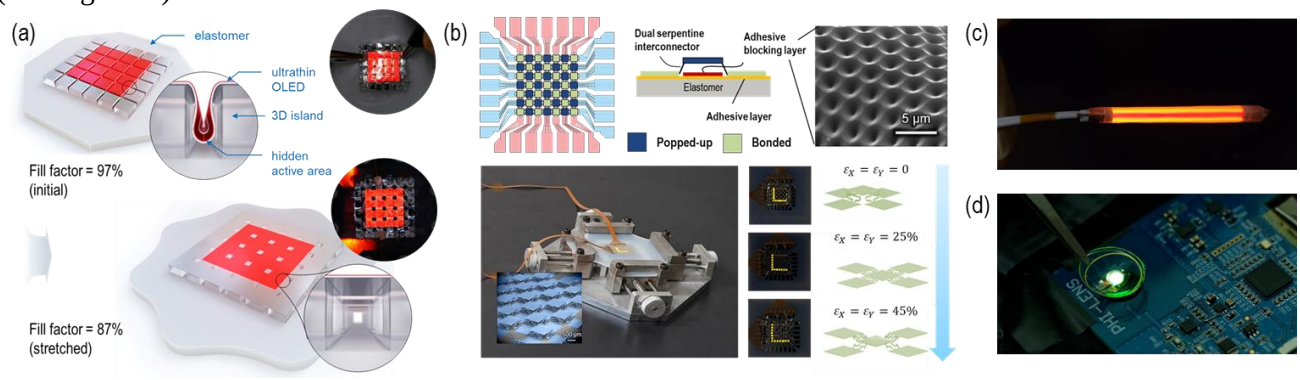


Fig. 1. Organic optoelectronic devices with various form factors: stretchable OLEDs for high geometrical fill factor1 based on (a) hidden active layers and (b) 3D pop-up architectures2, (c) OLED catheter for internal photobiomodulation3, (d) OLED contact lens for ERG4.

[References]

(1) D. Lee, S. B. Kim, T. Kim, D. Choi, J. H. Sim, W. Lee, H. Cho, J. H. Yang, J. Kim, S. Hahn, H. Moon, S. Yoo, *Nat. Commun.* **2024**, 15, 4349.

(2) S.-B. Kim, D. Lee, J. Kim, T. Kim, J. H. Sim, J.-H. Yang, S. J. Oh, S. Hahn, W. Lee, D. Choi, T.-S. Kim, H. Moon and S. Yoo, *Nat. Commun.*, **2024**, 15, 7802

(3) J. H. Sim, J. Kwon, H. Chae, S.-B. Kim, H. Cho, W. Lee, S. H. Kim, C.-W. Byun, S. Hahn, D. H. Park and S. Yoo, *Sci. Adv.*, **2023**, 9, eadh8619.

(4) J. H. Sim , H. Chae , S.-B. Kim , S. B. Shin , H. K. Hong , H. Cho , Y. H. Jung , D. Lee , M. Kim and S. Hahn , *ACS Nano*, **2025**, 54 , 3441 —3474

[IV 03-5]

Sustainable Silicone Lithography of Organic Semiconductors for Human-interactive RGB OLED Microdisplay

Do Hwan Kim[#,*]
Dept. of Chemical Engineering, Hanyang University, Seoul 04763, Korea.
Email: dhkim76@hanyang.ac.kr

Keywords: sustainable silicone lithography; OLED microdisplay, non-volatile etch-blocking layer; reactive ion etching; XR interactive display

Recently, ultrahigh-resolution patterning with high-throughput and high-fidelity is highly in demand for expanding the potential of organic light-emitting diodes (OLEDs) from mobile and TV displays into near-to-eye microdisplays. However, current patterning techniques so far suffer from low resolution, consecutive pattern for RGB pixelation, low pattern fidelity, and throughput issue. Here, we present a silicone engineered anisotropic lithography of the organic light-emitting semiconductor (OLES) that in-situ forms a non-volatile etch-blocking layer during reactive ion etching. This unique feature not only slows the etch rate but also enhances the anisotropy of etch direction, leading to gain delicate control in forming ultrahigh-density OLES patterns (up to 10,000 pixels per inch) through anisotropic photolithography as shown in Fig. 1. This patterning strategy inspired by silicon etching chemistry is expected to provide new insights into ultrahigh-density RGB micro-OLEDoS (OLED on Silicon) displays for XR interactive display.

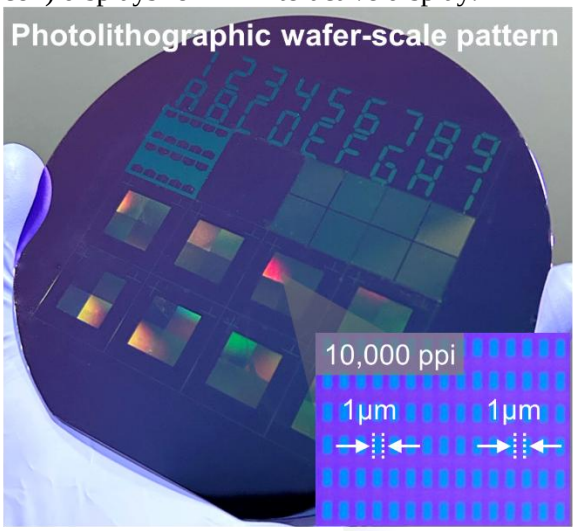


Fig. 1. Photograph of wafer-scale fabrication of OLES micropattern array achieved by anisotropic lithography

[Reference]

(1) H. Kweon et al., *Nat. Electron*., **2025**, 8, 66.

(2) H. Kweon et al., *Nat. Commun*., **2022**, 13, 6775.

(3) H. W. Park et al., *Adv. Mater.*, **2019**, 31, 1901400.

[IV 03-6]

Multi-functional ambipolar organic interlayer for high-performance perovskite solar cells

Jong H. Kim[#,*]
Department of Molecular Science and Technology, Ajou University, Suwon, Republic of Korea
Email: jonghkim@ajou.ac.kr

Keywords: Perovskite solar cells, Ambipolar interlayer, Trap passivation, Indoor power conversion efficiency, Stability

Perovskite solar cells (PSCs) are considered next-generation photovoltaic technologies due to their high efficiencies, simple fabrication, and compatibility with low-cost processes. However, their performance is still hindered by electronic traps, especially at the interfaces between the perovskite absorber and charge-transporting layers. These traps accelerate non-radiative recombination, reducing both efficiency and stability. Developing a strategy that simultaneously passivates interfacial defects and ensures balanced charge extraction is therefore essential.

Here, we introduce a multifunctional small molecule, DTAQTPPO, specifically designed to overcome these interfacial limitations. DTAQTPPO exhibits dual functionality: (i) effective trap passivation through strong interactions with the perovskite surface, and (ii) ambipolar charge extraction, enabling efficient transport of both holes and electrons. This combination allows DTAQTPPO to function as both an interfacial defect passivator and a versatile interlayer for charge transport, making it applicable to n-i-p and p-i-n device architectures. Incorporation of DTAQTPPO significantly enhanced device performance. For n-i-p and p-i-n PSCs, the power conversion efficiencies increased to 23.03% and 23.55% under 1 sun, and to 37.18% and 36.29% under 1000 lux LED indoor illumination, respectively. Moreover, DTAQTPPO improved the photovoltaic properties of PSCs fabricated through an anti-solvent-free process, achieving a PCE of 23.24% under 1 sun and 35.47% under LED.

These results establish DTAQTPPO as a multifunctional interlayer material for PSCs, capable of addressing interfacial traps while ensuring ambipolar charge transport. The demonstrated versatility across device configurations and fabrication methods highlights a promising route toward advancing both outdoor and indoor photovoltaic applications of perovskites.

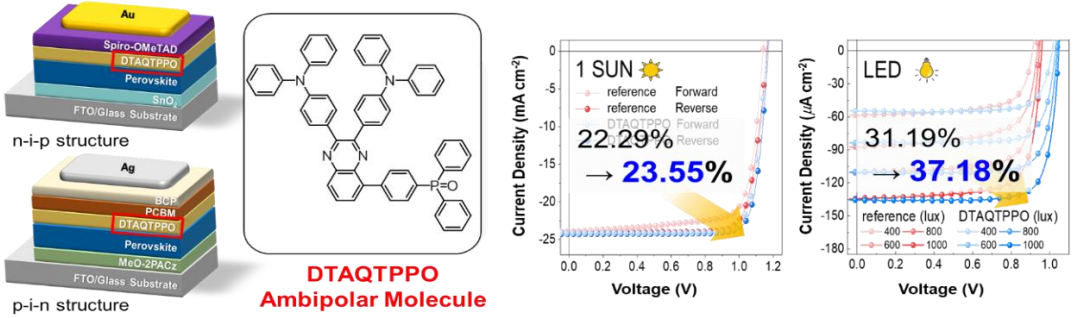


Fig. 1. Molecular structure of DTAQTPPO and photovoltaic properties of perovskite solar cells based on DTAQTPPO.

[Reference]

(1) Choi, S.W. Lee, H.J. Shim, S.J. Shin, H.W. Chun, S.E. Yoon, J.A. Prayogo, J. Seidel, J.S. Yun, D.W. Chang, J.H. Ki m.ad*v. Energy. Mater*., **2025**, 15, 2501113.

[IV 03-7]

Diazafluoren(on)es and Diazafluorenylidenes for Organic Optoelectronic Devices and Smart Materials

M.S. Kazantsev[#,*]
N.N. Vorozhtsov Novosibirsk Institute of Organic Chemistry SB RAS, Lavrentieva 9, Novosibirsk, Russia
e-mail: kazancev@nioch.nsc.ru

Keywords: diazafluorene, organic field-effect transistor, photoluminescence, toxic gas detection, electronic nose.

Fluorene-based materials are widely used in organic optoelectronics as bright emitters and excellent hole semiconductors[1]. Specifically, spirobifluorenes were used in OLEDs as emitters, host materials or hole-transporting layers. In turn, polyfluorenes are extensively used in OFETs and organic photovoltaic devices. Recently, diphenylfluorene was reported to have a good hole transport characteristics coupled with the photoluminescence quantum yield up to 80% and excellent lasing performence[2]. However, diazafluorene-containing analogues of abovementioned materials have been poorly explored though their nitrogen atoms could result in high electron affinity and electron transport[3,4]. Besides, 4,5-diazafluorene-containing materials are promising for sensorics because of the N-coordination opportunity and acidochromism[3,5].

Here, we report design, synthesis and detailed photo/electrophysical study of a series of 4,5-diazafluorene-containing derivatives and organic semiconductors/luminescent materials based on these molecules. Crystal structures of all the materials were solved by X-ray diffraction revealing extensive π-stacking interactions. ((9H-(diazafluorene)-9-ylidene)methyl)arylenes exhibited aggregation-induced emission, mechano- and thermochromism due to solid-state conformational rearrangements allowing us to obtain luminescent smart materials based on their coordination polymers. Linear 4,5-diazafluorene-derivatives were applied as active layers in single-crystal and thin-film organic field-effect transistors (OFETs) demonstrating air-stable electron transport. Electron mobility up to 0.02 cm2/Vs was measured for 2,7-diphenyl-4,5-diazafluorene-9-ylidene)malononitrile (P-DAF-CN). The good charge transport characteristics of this material stems from the lowest dipole moment among the molecules studied. P-DAF-CN thin-film OFETs demonstrated a sensor response toward sub-ppm level of hydrogen sulfide in air atmosphere paving the way toward electronic nose applications[6].

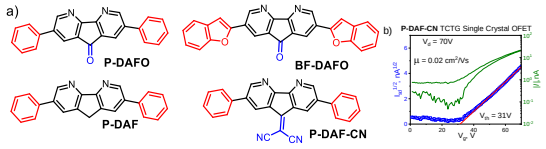


Fig. 1. a) structures of studied diazafluorene(on)es; b) transfer characteristics of P-DAF-CN single crystal OFET.

[Reference]

(1) Nhari, L. et al., *Dyes Pigm*. **2021,** 193, 109465.

(2) Liu, D. et al., *J. Am. Chem. Soc.* **2020**, 142, 6332.

(3) Cheshkina, D. et al., *Dyes Pigm.* **2024**, 229, 112261.

(4) Cheshkina, D. et al., *J. Phys. Chem. C* **2024**, 128, 15070.

(5) Ghosh, S. et al., *J. Mater. Chem. C* **2018**, 6, 3762.

(6) Cheshkina, D. et al., *ACS Appl.Mater. Interf*. **2025**, 10.1021/acsami.5c11469.

[IV 03-8]

Functional-Group-Oriented Anti-Solvent Additives for Photostable Perovskite Solar Cells

Wonjong Lee,[a] Muhammad Adnan,[a] Zobia Irshad,[a] Sunkyu Kim,[a] Siwon Yun,[a] Hyeji Han,[a] Minwoo Lee,[b] Dong Gyu Lee,[c] Hyeonsu Son,[c] Hyo Sik Chang,[a] Yen-Hung Lin,[d,*] Tae Kyung Lee,[c,*]Jae Sung Yun,[e,*] and Jongchul Lim[a,#,*]

[a]Graduate School of Energy Science and Technology, Chungnam National University, Daejeon, 34134, Republic of Korea.

[b]School of Materials Science and Engineering, University of New South Wales, Sydney, NSW 2052, Australia.

[c]School of Materials Science and Engineering, Gyeongsang National University (GNU), 501 Jinju-daero, Jinju 52828, Republic of Korea.

[d]Department of Electronic and Computer Engineering, The Hong Kong University of Science and Technology, Kowloon, Hong Kong, 999077, China

[e]Advanced Technology Institute, Department of Electrical and Electronic Engineering, University of Surrey, Guildford, Surrey GU2 7XH, UK

Email: jclim@cnu.ac.kr

Keywords: perovskite solar cells, anti-solvent additive, passivation, photostability, spectroscopy.

Metal-halide perovskite solar cells (PSCs) achieve high power-conversion efficiencies but remain susceptible to photo-induced degradation caused by mobile ions and phase segregation.[1,2] Here, we introduce positional isomers of pyridine-carboxylic acid, namely pyridine-2-carboxylic acid (2-PC) and pyridine-4-carboxylic acid (4-PC), as ultra-dilute anti-solvent additives and use a suite of structural, optical, and electrical probes to track their impact on film quality and device stability. Both additives enlarge grain size and lower trap density, yet 4-PC, which features the carboxyl group opposite the pyridine nitrogen, delivers the strong passivation, reducing trap density by $\approx$ 27%, suppressing light-induced red-shift behavior in photoluminescence, and enabling unencapsulated devices to preserve over 90% of their initial efficiency after 1,000 hours of 1-sun exposure. Spectroscopic and transient measurements reveal that 4-PC simultaneously passivates Pb-related defects and halide vacancies, inhibiting ion migration and halide phase segregation under operation. These results establish functional-group orientation as a powerful, easily implemented design rule for molecular passivators that substantially extend the operational lifetime of perovskite photovoltaics.

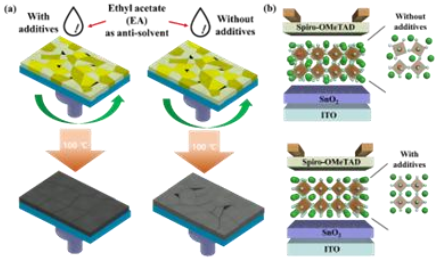


Fig. 1 a) Schematic diagram of the anti-solvent additive method for fabricating perovskite films, and b) device architecture with and without additives.

[Reference]

[1] H. Min, D. Y. Lee, J. Kim, G. Kim, K. S. Lee, J. Kim, M. J. Paik, Y. K. Kim, K. S. Kim, M. G. Kim, T. J. Shin, S. Il Seok, *Nature*, **2021**, 598, 444

[2] M. Adnan, W. Lee, Z. Irshad, S. Kim, S. Yun, H. Han, H. S. Chang, J. Lim, *Small*, **2024**, 1, 2402268

[IV 03-9]

Toward Scalable and Deployable Organic Ammonia Sensors: From Device Innovation to Real-World Applications

Li-Yin Chen[a,#,*], Y.-H. Cheng[a], C.-C. Chen[a], Z.-Y. Hsieh[a], Z.-H. Wang[a], Hsiao-Wen Zan[a], Hsin-Fei Meng[b]
[a]Department of Photonics, National Yang Ming Chiao Tung University, Hsinchu 300, Taiwan
[b]Institute of Physics, National Yang Ming Chiao Tung University, No. 1001, Hsinchu 300, Taiwan
Email: lychen@nycu.edu.tw

Keywords: Ammonia gas sensors, charge transport, device engineering, scalable deployment, real-world applications

Organic semiconductors provide a versatile platform for gas sensing, combining tunable molecular functionality with the potential for low-cost and scalable fabrication. This talk will present our recent progress in advancing organic semiconductor–based ammonia sensors toward practical deployment, focusing on strategies to reduce hardware complexity while maintaining high sensitivity and selectivity.

We demonstrate that rational device engineering, through vertical nanojunction architectures and controlled doping schemes, can dramatically enhance sensor response and operational stability at room temperature1,2. Moreover, our studies have identified organic materials with strong potential to meet the stringent requirements of real-world sensing applications. These innovations enable direct signal acquisition with simple, low-cost instruments, thus eliminating the reliance on bulky laboratory equipment. As a result, portable organic gas sensors with ppb-level detection limits and strong resistance to humidity interference become feasible.

Beyond device-level achievements, the broader translational potential of these sensors and their pathway from laboratory innovation to real-world validation through ongoing collaborations will be also highlighted.

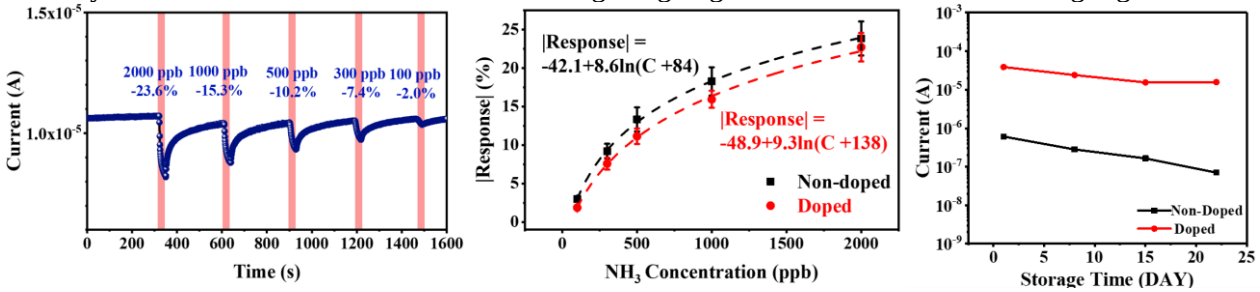


Fig. 1. Ammonia sensing performance and device stability.

[References]

(1) Y.-H. Cheng, C.-C. Chen, L.-Y. Chen, Y.-J. Ma, H.-K. Hsiao, Y.-C. Lu, J.-K. Tu, H.-W. Zan, H.-F. Meng, H.-W. Lin, Y.-H. Tai, M.-H. Chen, J. *Taiwan Inst. Chem. Eng*., **2025,** 174, 106197.

(2) B.-X. Chen, L.-Y. Chen, H.-W. Zan, H.-F. Meng, C.-A. Hsieh, J.-B. Yang, M.-H. Chen, Y.-H. Cheng, *Sens. and Actuators: B. Chem.*, **2022**, 361, 131723.

[IV 03-10]

Molecular dynamics simulation of organic materials for mechanical, chemical and spectroscopic predictions

Toshihiro Shimada [#,*]
Division of Applied Chemistry, Hokkaido University, Kita 13 Nishi-8, Kita-ku, Sapporo 060-8628, Japan
Email: shimadat@eng.hokudai.ac.jp

Keywords: molecular dynamics, computer simulation, organic molecules, polymers

Computer simulations are useful for understanding nanoscopic processes that cannot be observed by experiments. I will present several topics related molecular dynamics simulations. (1) Crystal growth of organic semiconductor molecules, (2) Mechanics of polymers and graphenes[1], including abrasion and chemical reactions, and (3) Vibrational spectroscopy (Fig.1)[2].

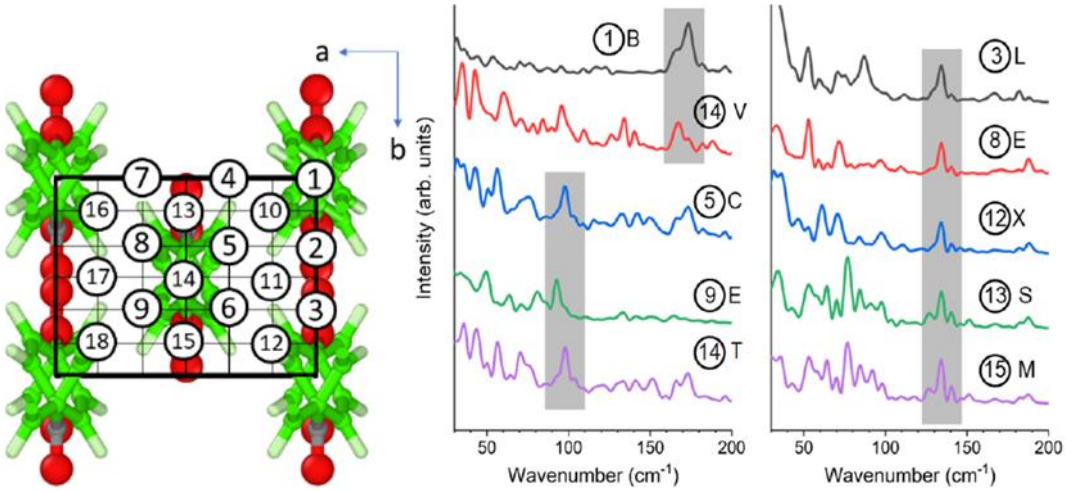


Fig. 1. Simulated local vibrational spectra of PEEK from molecular dynamics simulations.

[References]

(1) Yang, X.; Yokokura, S.; Nagahama, T.; Yamaguchi, M.; Shimada, T. *Polymers* 14, 5406 (**2022**).

(2) Ando, T., Yokokura, S., Waizumi, H., Suzuki, H., Kawashima, Shimada, T. *C - J. of Carbon Research* 11, 59 (**2025**).

[IV 03-11]

Study on Charge Carrier Dynamics of Organic Photovoltaics and Photocatalysts

Hyojung Cha[#,*]
School of Energy Engineering, Kyungpook National University, Daegu, Republic of Korea
Email: hcha@knu.ac.kr

Keywords: hydrogen generation, organic catalysis, conjugated polymer, nanoparticles, charge carrier dynamics

Photocatalytic hydrogen generation is an emerging method for achieving sustainable energy production and addressing energy shortages and environmental challenges. Compared to their inorganic counterparts, organic semiconductor-based photocatalysts offer several advantages, including tunable structural and optoelectronic properties, low cost, and stability. However, their photocatalytic efficiency is limited by inherent properties, such as the formation of Frenkel excitons, the presence of numerous energetic defects, and low charge separation efficiency. To achieve superior performance from these organic photocatalysts, it is crucial to understand the relationship between molecular design and charge carrier dynamics within photocatalytic processes. For this reason, recent research on organic photocatalysis for hydrogen evolution has focused on identifying limiting factors and elucidating the fundamental charge carrier behaviors that determine the performance of organic photocatalysts, utilizing advanced time-resolved analysis tools. Here, we address the charge carrier dynamics in organic photocatalytic nanoparticles for hydrogen evolution. We investigate charge carrier behaviors, including photoinduced charge generation and transport within the bulk of the organic photocatalyst, as well as charge transfer and charge-induced redox reactions at the interface within the photocatalytic system. These characteristics, as influenced by molecular structures, are studied using time-resolved analytical methodologies, including transient spectroscopy. The aim is to provide a deeper understanding of the correlation between charge carrier dynamics, molecular structure, and photocatalytic performance.

[References]

(1) S. Kim, Y. Yu, H. Choi, G. Ham, S. An, S. Lee, J. Yang, D. S. Chung, J. Lee, H. Cha, *EES Catal.*, **2025**, accepted.

(2) W. Jung, J. Cho, S. An, S. Yun, D. S. Chung, H. Cha, J. Lim, T. Park, *Adv. Energy Mater*., **2025**, accepted.

(3) W. Jung, S. An, G. Ham, C. Kim, S. Lee, J. Yang, D. S. Chung, H. Cha, T. Park, *EES Catal.* **2025**, *3*, 775.

(4) J. Choi, W. Jung, S. Gonzalez-Carrero, J. R. Durrant, H. Cha, T. Park, *Energy Environ. Sci.* **2024**, *17*, 7999.

(5) S. An, K.-J. Jeong, S. Z. Hassan, G. Ham, S. Kang, J. Lee, H. Ma, J. Kwon, S. Y. Jeong, J. Yang, H. Y. Woo, H.-H. Cho, H. Cha, C. Y. Son, D. S. Chung, *Adv. Sci.* 2024, **11**, 2309786.

[IV 03-12]

Introduction to Angewandte Chemie - Opening the Editor's Black Box

Haeryung Lee[#,*]
Angewandte Chemie-Deputy Editor, Wiley
E-mail: halee@wiley.com

Publishing research findings is a crucial aspect of a scientist's professional life, yet many scholarly journals are often perceived as black boxes. This perception arises primarily due to two reasons: a lack of transparency in the publication process and a communication gap between the editorial office and the author. This presentation will provide a concise overview of Wiley chemistry journals, including Angewandte Chemie, and will cover current trends, scope, and challenges in scientific publishing. We will discuss ethical considerations, the interaction between publishers and authors, and the ongoing transformation of the publishing arena. Additionally, the editorial process will be demystified, offering tips on selecting an appropriate journal, focusing on preparation and presentation from an editor's and referee's perspective, and enhancing the discoverability of your paper post-publication.

[IV 04-1]

A Metal-Free Phthalocyanine Additive for Defect Passivation and Processing Tolerance in High-Efficiency Perovskite Solar Cells

Chih-Ping-Chen[b], Chih-Hsin Chen[a,#,*]
[a]Department of Chemistry, Tamkang University, New Taipei City 25137, Taiwan
[b]Department of Materials Engineering and Organic Electronics Research Center, Ming Chi University of Technology, New Taipei City 24301, Taiwan
Email: chc@mail.tku.edu.tw

Keywords: Metal-free phthalocyanine, Perovskite solar cells, Defect passivation, Additive engineering, Indoor photovoltaics.

Metal-free phthalocyanines (Pcs) have rarely been explored in perovskite solar cells (PSCs) due to poor solubility and limited processability.1,2 Here, we introduce CG-0, a fully substituted metal-free Pc bearing peripheral chlorine atoms and non-peripheral ethoxy chains that confer exceptional solubility, near-infrared absorption, and photochemical robustness. As an additive in wide-bandgap (WBG) PSCs, CG-0 promotes high-quality crystallization, passivates defects, and suppresses non-radiative recombination. Strikingly, ultra-high doping levels (1.75 mM) are tolerated without performance loss, yielding a PCE of 20.41% (FF = 83.2%) under AM 1.5G and 38.60% under 1000 lux white LED. At high loadings, CG-0 also imparts a vivid, tunable film color, enabling aesthetic and multifunctional device designs. This work establishes a rational molecular design paradigm in which solubility-driven processability, multi-point defect passivation, and interfacial stabilization are integrated into a single additive. The approach not only delivers record WBG PSC efficiencies under both solar and indoor light, but also breaks the constraint of fixed device appearance, opening avenues toward efficient, color-adaptive perovskite photovoltaics.

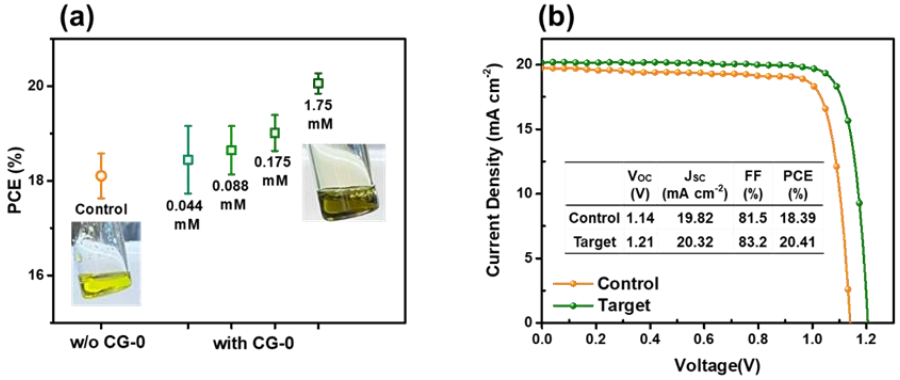


Fig. 1. (a) PCEs of WBG PSCs fabricated without CG-0 (control) and with various CG-0 additive concentrations. (b) J–V curves of the best-performing control and CG-0–containing devices measured under standard one-sun AM 1.5G illumination.

[References]

(1) G. Qu, Y. Qiao, J. Zeng, S. Cai, Q. Chen, D. Wang, D. Khan, L. Huang, B. Xu, J. Chen, T. El-Assaad, Y.-G. Wang, D. V. McGrath, Z.-X. Xu, *Nano Energy* **2023**, *118*, 108974.

(2) G. Qu, D. Khan, F. Yan, A. Atsay, H. Xiao, Q. Chen, H. Xu, I. Nar, Z.-X. Xu, J. *Energy Chem*. **2022**, *67*, 263–275.

[IV 04-2]

Detecting Nitrogen Environmental Pollution using Amine/Sulfur Gas Detection

Hsiao-Wen Zan[a,b,#,*], Ching-Chieh Lu[a], Moumita Deb[a,b], Chun-Cheng Liu[b], Hsin-Fei Meng[c,*], Li-Yin Chen[a], Yu-Yu Huang[d]
[a]Department of Photonics, [b]Institute of Pioneer Semiconductor Innovation, [c]Institute of Physics, 1001 Ta Hsueh Rd., NYCU, Taiwan.
[b]Agriculture Technology Translation Center, Taiwan Agriculture Research Institute, Ministry of Agriculture, Executive Yuan, Taichung 413008, Taiwan
Email: hsiaowen@nycu.edu.tw, meng@nycu.edu.tw

Keywords: ammonia emission, eutrophication, organic semiconductor, sol-gel metal oxide

In recent decades, with the growth of agricultural and animal husbandry activities, environmental pollution from fertilizers and animal waste has become increasingly serious. Ammonia nitrogen pollution can remain in the soil or enter rivers and lakes. Ammonia evaporates from the soil into the atmosphere, where it reacts with sulfur dioxide and nitrogen oxides to produce secondary particulate matter (PM2.5). Ammonia and nitrogen in water contribute to eutrophication, reducing dissolved oxygen levels, diminishing biodiversity, and even causing mass fish kills. Existing detection tools often face challenges such as cost, time consumption, and susceptibility to interference. We propose using ammonia and sulfur gas detectors made from organic semiconductors or metal oxide semiconductors, combined with innovative system design, to effectively improve the efficiency and sensitivity of pollution detection. The water nitrogen pollution can be detected in 2 mins by OSC ammonia sensing system to reflect pollution level from drinking water, chronic pollution, to acute pollution[1]. With ultra-sensitive H2S gas sensors[2], the green algae detection result reveal that the proposed sensor system may serve as a fast eutrophication screening tool in early stage eutrophication.

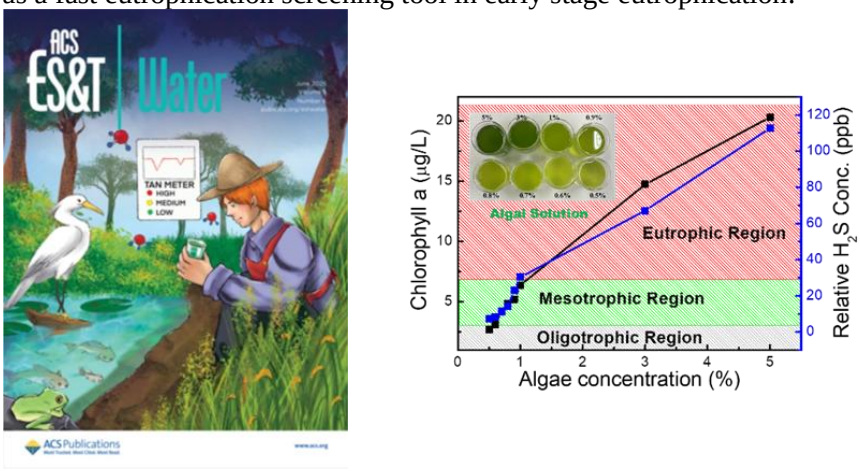


Fig. 1. (left) Detecting water nitrogen pollution using portable ammonia gas detection system. (right) The good correlation between effective H2S gas concentration and “Chl a” eutrophication level in green algae solution.

[References]

(1) C.-L. Chiang, Y.-Y. Huang, T.-Y. Liu, Y.-Y. Chen, O. Soppera, L.-Y. Chen, H.-W. Zan. *ACS EST Water* **2025**, 5, 6, 2965–2974 (Supplementary Cover)

(2) Deb, M.; Lu, C.-J.; Zan, H.-W. *ACS Sens.* **2024**, *9* (9), 4568– 4577 (Front Cover)

[IV 04-3]

Mitigating Voltage Loss through Interfacial Engineering for High-Performance Perovskite/Organic Tandem Solar Cells

Jung Geon Son[a], Dong Suk Kim[a], Jin Young Kim [a,#,*]
[a]Graduate School of Carbon Neutrality, School of Energy and Chemical Engineering
Ulsan National Institute of Science and Technology (UNIST), Ulsan 44919, Republic of Korea
Email: jykim@unist.ac.kr

Keywords: self-assembled monolayers, perovskite solar cells, perovskite/organic tandem solar cells

Perovskite/organic tandem solar cells (POTSCs) offer great potential to surpass the Shockley–Queisser limit by reducing thermalization losses. However, the performance of wide-bandgap perovskite top cells remains limited by substantial open-circuit voltage (VOC) losses, which directly constrain the efficiency of tandem devices. Here, we address this critical challenge through interfacial engineering of hole-selective layers (HSLs). By tailoring the molecular interactions at the perovskite/electrode interface, we achieve improved energy level alignment, enhanced film homogeneity, and favorable crystal growth, which together suppress non-radiative recombination and reduce lattice strain. These advances enable wide-bandgap perovskite solar cells with significantly enhanced VOC values and stable device operation. When integrated into tandem architectures, the optimized interface design delivers power conversion efficiencies exceeding 25% with record-high VOCs above 2.2 V and excellent fill factors. Moreover, the devices exhibit remarkable operational stability, retaining over 80% of their initial efficiency under prolonged light soaking and thermal stress. Our results highlight the central role of interfacial engineering in overcoming voltage loss while ensuring both efficiency and stability, providing a viable pathway for the practical deployment of high-performance POTSCs[1].

[References]

(1) Son, J. G., Ameen, S., Roe, J., Park, S., Seo, J., Kim, Kim, B., *Adv. Energy Mater*. **2025**, 2404092.

[IV 04-4]

Dibenzofuran-Based Charge Transport Materials for High-Efficiency and Long-Lifetime OLEDs and QLEDs

Youngu Lee [#,*]
Dept. of Energy Science and Engineering, DGIST, 333, Techno Jungang Daero, Hyeonpung-Eup, Dalseong-Gun, Daegu, KOREA.
Email: youngulee@dgist.ac.kr

Keywords: Dibenzofuran, Hole transport materials, Electron transport materials, OLED, QLED

Organic light-emitting diodes (OLEDs) and quantum dot light-emitting diodes (QLEDs) have revolutionized the display industry. In particular, next-generation QLEDs are attracting significant attention as solution-processable inorganic nanocrystals that offer tunable emission wavelengths and stable, high–color-purity luminescence. Moreover, device fabrication via solution-based methods such as slot-die coating and inkjet printing provides a cost-effective route to large-area displays compared to conventional vacuum deposition. However, achieving efficient solution-processed OLEDs and QLEDs remains challenging due to the poor solubility and suboptimal physical properties of hole-transport materials (HTMs) and electron-transport materials (ETMs). In this talk, I will introduce a series of novel dibenzofuran-based materials designed as both HTMs and ETMs for high-performance OLEDs and QLEDs. 1-3 Dibenzofuran-based π-conjugated frameworks have emerged as versatile building blocks for organic optoelectronics, offering rigid planar structures, high thermal stability, and tunable electronic properties. Through strategic incorporation of electron-donating and electron-withdrawing groups, we achieved precise control over the highest occupied and lowest unoccupied molecular orbital (HOMO/LUMO) levels, enabling balanced charge injection and transport. Comprehensive thermal, photophysical, and electrochemical analyses confirmed their high glass-transition temperatures, excellent morphological stability, and favorable energy level alignment with common emitters. Devices employing these dibenzofuran-based charge transport layers exhibited significantly reduced driving voltages, enhanced external quantum efficiencies, and improved operational stability compared to those using conventional transport materials.

[References]

(1) Y. Hwang, H. Jung, J. Kim, D. Lee, Y. Lee, *Small*, **2025**, e04867

(2) Y. Hwang, H. Jung, J. Kim, J. Park, A. Maheshwaran, B. Kang, Y. Lee, *ACS Appl. Mater. Interfaces* **2025**, *17*, 6668

(3) Maheshwaran, A.; Bae, H.; Park, J.; Jung, H.; Hwang, Y.; Kim, J.; Park, C.; Kang, B.; Song, M.; Lee, Y. *ACS Appl. Mater. Interfaces* **2023**, *15*, 45167– 45176

[IV 04-5]

Organic Photodiode : Beyond RGB Sensing

Dae Sung Chung[#,*]
Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, 37673, Republic of Korea
Email: dchung@postech.ac.kr

Keywords: Organic photodiodes (OPDs), image sensors, vis-SWIR detection, CMOS integration

Over the past two decades, extensive research has been conducted on organic photodiodes (OPDs), and it has been demonstrated that OPDs already exhibit significant advantages over silicon-based photodiodes at the single-device level. However, integrating OPDs with CMOS technology for image sensor applications requires entirely different considerations from both material and process perspectives. In this talk, I will discuss key material and process technologies essential for applying OPDs to fingerprint recognition sensors, PPG sensors, passive/active matrix image sensors, and Vis-SWIR integrated image sensors. Specifically, I will address how to achieve photomultiplication, large dynamic range, facile charge separation, and visible transparency from OPDs—each of which is crucial for these applications. Based on this discussion, we will explore the various possibilities for the industrial adoption of OPDs in the near future.

[IV 04-6]

Development of high-performance Sn based perovskite transistors

Yong-Young NOh[#,*]
Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, South Korea
Email: yynoh@postech.ac.kr

Keywords: Halide perovskites, Thin film transistor, P-type

Developing high-mobility p-type semiconductors that can be grown using silicon-compatible processes at low temperatures, has remained challenging in the electronics community to integrate complementary electronics with the well-developed n-type counterparts[1].

This presentation will discuss our recent progress in developing high-performance p-type semiconductors as channel materials for thin film transistors. For the first part of my talk, I will present high-performance tin (Sn2+) halide perovskite based p-type transistors using cesium-tin-triiodide-based semiconducting layers[2.3]. The optimized devices exhibit high field-effect hole mobilities of over 50 cm2 V−1 s−1, large current modulation greater than 108, and high operational stability and reproducibility[4]. In addition, we explore triple A-cations of caesium-formamidinium-phenethylammonium to create high-quality cascaded Sn perovskite channel films. As such, the optimized TFTs show record hole mobilities of over 70 cm2 V−1 s−1 and on/off current ratios of over 108, comparable to the commercial low-temperature polysilicon technique level. In the last part, I would like to briefly introduce our recent halide perovskite transistors fabricated by thermal evaporation[5].

[References]

(1) A. Liu, Y.-Y. Noh et al, Nature, *629*, 798–802 (**2024**)

(2) A. Liu, Y.-Y. Noh et al, Nature Electronics *5*, 78-83 (**2022**)

(3) H. Zhu, Y.-Y. Noh et al, Nature Electronics *6*, 650-657 (**2023**)

(4) A. Liu, Y.-Y. Noh et al, Nature Electronics *6*, 559-571 (**2023**)

(5) Y. Reo, Y.-Y. Noh et al, Nature Electronics *8*, 403-410 (**2025**)

[IV 04-7]

Organic Floating-Gate Transistors for Optoelectronic Nonvolatile Memory and Artificial Synapse Applications

Takashi Nagase[a,b, #,*]
[a]Department of Physics and Electronics, Osaka Metropolitan University
[b]The research Institute for Molecular Electronic Devices, Osaka Metropolitan University,
1-1 Gakuen-cho, Naka-ku, Sakai, Osaka 599-8531, Japan
Email: nagase@omu.ac.jp

Keywords: organic transistor; solution process; optoelectronic nonvolatile memory; artificial synapse

Exploring the optical memory characteristics of organic field-effect transistors (OFETs) with floating-gate structures provides an effective approach for developing flexible and printed memory devices with a large memory window, as well as artificial synapse devices. In our previous work, we demonstrated that the use of vertical phase separation in solution-processed organic blend films of poly(methylmethacrylate) (PMMA) and 6,13-bis(triisopropylsilylethynyl)pentacene (TIPS-pentacene) enables the fabrication of OFETs with organic semiconductor floating gates via spin-coating processes (Fig. 1(a)). The developed OFET memories exhibited large threshold voltage (Vth) shifts only when programmed under light illumination1,2 (Fig. 1(b)). This feature makes it possible to realize solution-processable organic image sensor arrays with built-in memory functionality in each pixel (Fig. 1(c)), leading to enhanced photoresponsivity. Furthermore, OFET memories with organic floating-gate layers showed a large dependence of drain current on the intensity of red LED light, owing to the emergence of short-term synaptic plasticity under red light3 (Fig. 1(d)), enabling pre-processing functions for image sensors, such as contrast enhancement and noise reduction. In this presentation, I will report wavelength dependent characteristics in floating-gate OFET memories based on dinaphtho[2,3-b:2',3'-f]thieno[3,2-b]thiophene (DNTT) for their applications in organic image sensors with synaptic functions and analog synapse devices.

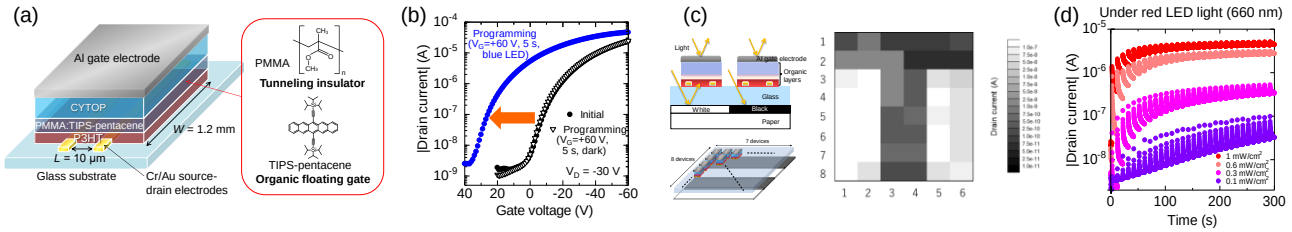


Fig. 1. (a) Structure of a solution-processable floating-gate OFET memory. (b) Transfer characteristics of a P3HT-based OFET memory with a PMMA:TIPS-pentacene (80:20) floating-gate layer, measured after programming under blue LED illumination and erasing in the dark. (c) Black-and-white pattern reproduced from the recorded drain currents of a memory array consisting of PBTTT OFET memory devices. (d) Light-intensity-dependent drain current of the P3HT OFET memory under repeated programming under red LED illumination.

[References]

(1) F. Shiono, H. Abe, T. Nagase, T. Kobayashi, H. Naito, *Org. Electron.*, **2019**, *67*, 109.

(2) H. Abe, R. Hattori, T. Nagase, M. Higashinakaya, S. Tazuhara, F. Shiono, T. Kobayashi, H. Naito, *Appl. Phys. Express*, **2021**, *14*, 041007.

(3) K. Morikawa, S. Hattori, N. Nishida, T. Kobayashi, H. Naito, T. Nagase, *Proceedings of the International Display Workshops*, **2023**, *30*, 1120.

[IV 04-8]

Crystallized PEDOT:PSS-Based Unconventional Energy Conversion and Storage Systems

Myung-Han Yoon[#,*]
Department of Materials Science and Engineering, Gwangju Institute of Science and Engineering (GIST)
123 Cheomdangwagi-ro, Buk-gu, Gwangju 61005, Republic of Korea
Email: mhyoon@gist.ac.kr

Keywords: PEDOT:PSS, self-fusion, swelling, energy conversion, energy storage

Poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) has emerged as a versatile mixed ionic–electronic conductor for next-generation energy technologies. In this work, we present unconventional strategies to exploit the unique swelling and self-fusion behaviors of PEDOT:PSS in aqueous conditions for scalable energy conversion and storage applications. First, aqueous ion penetration was harnessed to achieve volumetric incorporation of precious metal nanostructures through controlled electrodeposition, leading to a novel electrocatalytic system for efficient water splitting. Second, we demonstrate the spontaneous self-fusion of PEDOT:PSS fibers into multi-fibrillar yarns, enabling scalable architectures for electrochemical energy storage devices in combination with metallic carbon nanotube-based core fibrillar yarns. By integrating these effects, we realize high-capacitance core–shell type fiber supercapacitors with scalable volumetric capacitance, bridging molecular-level ionic interactions with device-level performance. These results highlight the multifunctional roles of PEDOT:PSS as both an electrochemically active medium and a structural component, opening pathways for sustainable and scalable unconventional energy conversion and storage systems.

[IV 04-9]

Design and study of novel organic mixed ionic-electronic conductors

Micaela Matta[#,*]
King's College London, Department of Chemistry, Strand WC2R 2LS, London, United Kingdom
E-mail: micaela.matta@kcl.ac.uk

This talk will focus on our group's recent work on de novo design and screening of bioinspired semiconductors comparing two strategies: a computational funnel and a genetic algorithm. We demonstrate that, even with a small combinatorial pool of chemical fragments, it is possible to design promising semiconductors that can incorporate bioinspired units. I will also highlight our ongoing efforts towards understanding melanins, a mixed conducting material with unique photophysical, antioxidant and conducting properties.

[IV 04-10]

Molecular Dipole Engineering of Polymer Semiconductors for Stretchable and High-Performance Electronics

Chien-Chung Shih[#,*]
Department of Chemical and Materials Engineering, National Yunlin University of Science and Technology
Yunlin 64002, Taiwan.
Email: shihcc@yuntech.edu.tw

Keywords: stretchable, polymer semiconductors, transistors, organic photodiodes

Achieving mechanical stretchability with high electronic properties remains a key challenge in polymer semiconductors.1 This talk introduces a dipole engineering strategy that uses isomeric linkers with increasing dipole moments to modulate polymer microstructure and address this trade-off.2 The resulting polymer features a decoupled microstructure, combining reduced long-range crystallinity with intensified short-range aggregation, enabling a 4-fold increase in crack onset strain and a 1.5-fold improvement in field-effect mobility. When applied in organic photodiodes, the material delivers higher quantum efficiency and detectivity, maintaining stable performance under 80% strain. It also improves volumetric capacitance and transconductance in organic electrochemical transistors. These results highlight dipole modulation as an effective approach to simultaneously optimize the mechanical and optoelectronic performance of stretchable polymer semiconductors.

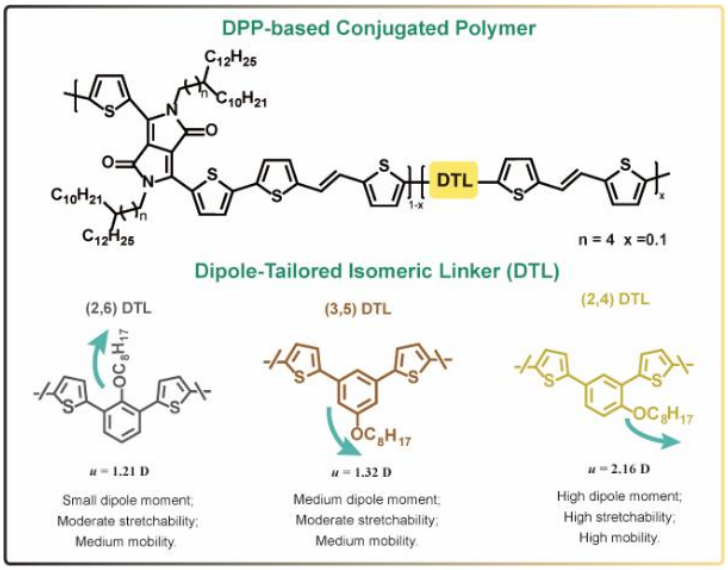


Fig 1. Dipole-tailored isomeric linkers decouple aggregation from crystallinity in conjugated polymers, enabling simultaneous improvements in stretchability and charge transport property.

[References]

(1) Y.-C. Weng, C.-C. Kang, T.-W. Chang, Y.-T. Tsai, S. Khan, T.-M. Hung, C.-C. Shih*, *Adv. Mater*. **2025**, 37, 2411572

(2) C.-C. Kang, T.-M. Hung, S.-T. Lu, T.-C. Lu, C.-C. Shih*, *J. Am. Chem. Soc*. **2025**, 147, 29282.

[IV 04-11]

Practical Applications of Molecular Simulations in Perovskite Solar Cells

Tae Kyung Lee[#,*]
Department of Materials Engineering and Convergence Technology, Gyeongsang National University (GNU),
501 Jinju-daero, Jinju 52828, Republic of Korea
Email: tklee8865@gnu.ac.kr

Keywords: Molecular Modeling, Multiscale Simulations, Density Functional Theory Calculations, Molecular Dynamics Simulations, Perovskite Solar Cells

With the rapid advancement of computing power, simulation technologies have undergone remarkable development. Especially, molecular simulations have emerged as powerful methods in material science, as they enable the elucidation of macroscopic behaviors based on atomic and molecular-level mechanisms. Leveraging these simulation approaches provides a promising pathway for future investigations, facilitating close integration of experimental observations with theoretical modeling. This presentation highlights the practical applications of molecular modeling and multiscale simulations in unraveling the fundamental physicochemical processes that govern the performance, stability, and degradation of perovskite solar cells[1-3]. As interdisciplinary convergence increasingly drives the development of next-generation energy technologies, the strategic utilization of molecular simulation is expected to play a pivotal role in accelerating the rational design and optimization of high-efficiency, durable perovskite solar cells.

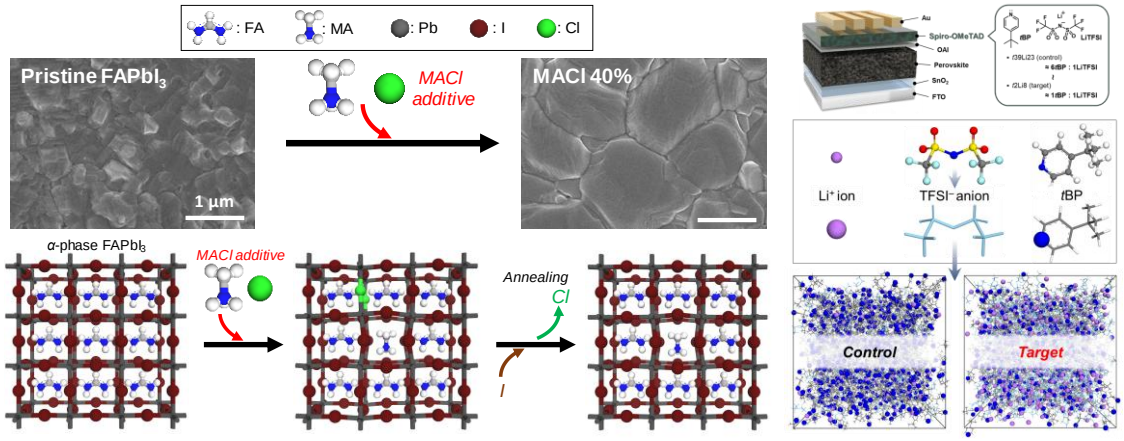


Fig. 1. Molecular Simulations for Perovskite Solar Cells.[1,2]

[References]

(1) M. Kim, G.-H. Kim, T. K. Lee, I. W. Choi, H. W. Choi, Y. Jo, Y. J. Yoon, J. W. Kim, J. Lee, D. Huh, H. Lee, S. K. Kwak, J. Y. Kim, D. S. Kim, *Joule* **2019**, *3*, 2179.

(2) Y. S. Shin, J. W. Song, D. G. Lee, J. Lee, J. Seo, J. Roe, G. Y. Shin, D. Kim, J. Yeop, D. Lee, M. Kim, Y. Jo, H. Jang, J. G. Son, W. Lee, J. Son, S. Park, S. Cho, T. J. Shin, G.-H. Kim, J. Y. Kim, T. K. Lee, M. Grätzel, D. S. Kim, *Joule* **2025**, 9, 101779.

(3) Y. S. Shin, J. Lee, D. G. Lee, J. W. Song, J. Seo, J. Roe, M. J. Sung, S. Park, G. Y. Shin, J. Yeop, D. Lee, C. H. Yoon, M. Kim, J. G. Son, G.-H. Kim, S. Cho, J. Y. Kim, T. K. Lee, D. S. Kim, *Energy Environ. Sci.* 2025, **18**, 3269.

[IV 05-1]

Photoluminescence Enhancement up to 350 K of Monophase α-$FAPbI_3$ Quantum Dots Synthesized via Tailored Hot Injection

Nurwarrohman Andre Sasongko, Jaesong Heo, and Myeongkee Park[#,*]
BB21 Plus Program, Department of Chemistry, Pukyong National University, Busan, Republic of Korea.
Email: bikeplay@pknu.ac.kr

Keywords: Perovskite, Quantum dot, $FAPbI_3$, Photoluminescence, Hot Injection

Enhancing the photoluminescence (PL) performance of photoactive α-formamidinium lead iodide (α-$FAPbI_3$) perovskite quantum dots (QDs) at elevated temperatures is essential for their integration into advanced optoelectronic devices such as light-emitting diodes, photodetectors, and solar cells. However, achieving strong and thermally stable PL while maintaining structural purity remains a considerable challenge due to interference from inevitable δ-$FAPbI_3$ impurities and crystal defects.[1] In this study, we developed a tailored hot-injection strategy to establish optimized synthesis conditions for phase-pure α-$FAPbI_3$ QDs (Figure 1). By precisely tuning the ligand ratio, washing solvent ratio, and growth temperature, we obtained highly uniform QDs (10.4 ± 1.1 nm) with dominant (001), (002), and (003) facets, high crystallinity, and extended PL lifetimes (~150 ns). Temperature-dependent PL measurements revealed sequential phase transitions from γ-tetragonal-1 to β-tetragonal-2 to α-cubic at approximately 140 and 250 K, respectively. Notably, the α-cubic phase exhibited a pronounced enhancement in PL intensity up to 350 K, indicative of improved carrier mobility at elevated temperatures. These findings provide critical insights into the structure–property relationships of monophase α-$FAPbI_3$ QDs and underscore their potential for high-performance optoelectronic applications operating under thermal stress.

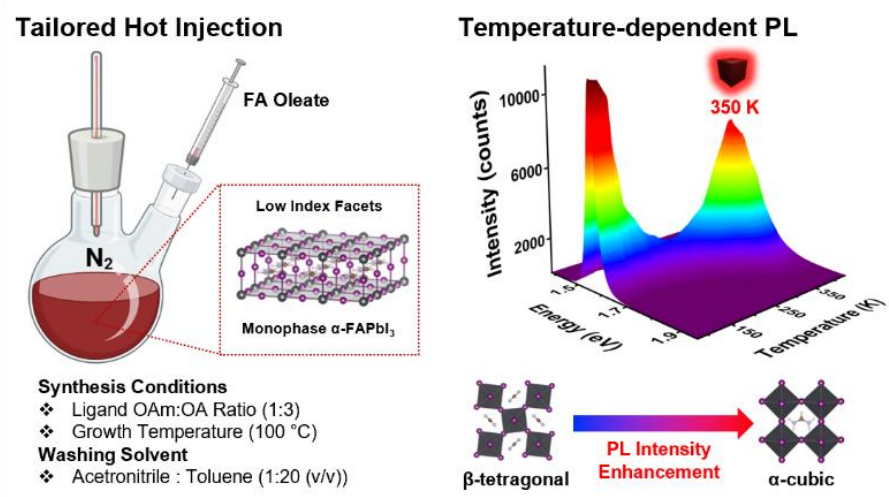


Fig. 1. Synthesis of α-FAPbI3 quantum dots via tailored hot injection. PL intensity enhancement up to 350 K, resulting from a phase transition from β-tetragonal to α-cubic structure.

[References]

(1) S. Wang, Q. Zhao, A. Hazarika, S. Li, Y. Wu, Y. Zhai, X. Chen, J. M. Luther, G. Li, *Nat. Commun.* **2023**, 14, 2216.

[IV 05-2]

Naphthalenediimide (NDI)- Based N-type Conjugated Polymers as Organic Cathodes for Lithium-ion Batteries

Wonho Lee[a,#,*]
[a]Department of Polymer Science and Engineering, Kumoh National Institute of Technology (kit), Gumi Gyeongbuk 39177, Republic of Korea.
Email: 1holee@kumoh.ac.kr

Keywords: organic cathode, n-type conjugated redox polymers, structure modification, high temperature performance**.**

Conjugated n-type polymers have long been explored as organic cathodes for lithium-ion batteries (LIBs), yet the widely studied P(NDI2OD-T2) has received limited attention as a practical cathode because of its modest capacity (~55 mAh g^{-1}).[1,2] Here, we report the first systematic effort to re-engineer this prototypical polymer through side-chain shortening and donor simplification. Replacing bulky 2-octyldodecyl (2OD) chains with 2-butyloctyl (2BO) and simplifying the bithiophene (T2) donor to a vinyl linker (V) produced P(NDI2BO-V), which delivers a 1.51-fold higher capacity (56.9→86.0 mAh g^{-1}) while retaining excellent cycling stability. Crucially, we show that n-type polymers can achieve unprecedented cycling stability at elevated temperatures: both polymers remained stable at 60 °C, where small molecules fail, with P(NDI2OD-T2) keeping 97% after 1000 cycles and P(NDI2BO-V) 80% after 600. Mechanistic studies combining electrochemical analysis with density functional theory and molecular dynamics simulations reveal how donor linkages dictate structure and transport. Crystalline P(NDI2OD-T2) exhibits higher electronic conductivity and undergoes a one-step two-electron redox process, whereas amorphous P(NDI2BO-V) offers enhanced Li^+ diffusivity but follows a stepwise pathway. This work establishes a molecular design framework for conjugated polymer cathodes that combine high capacity, efficient charge transport

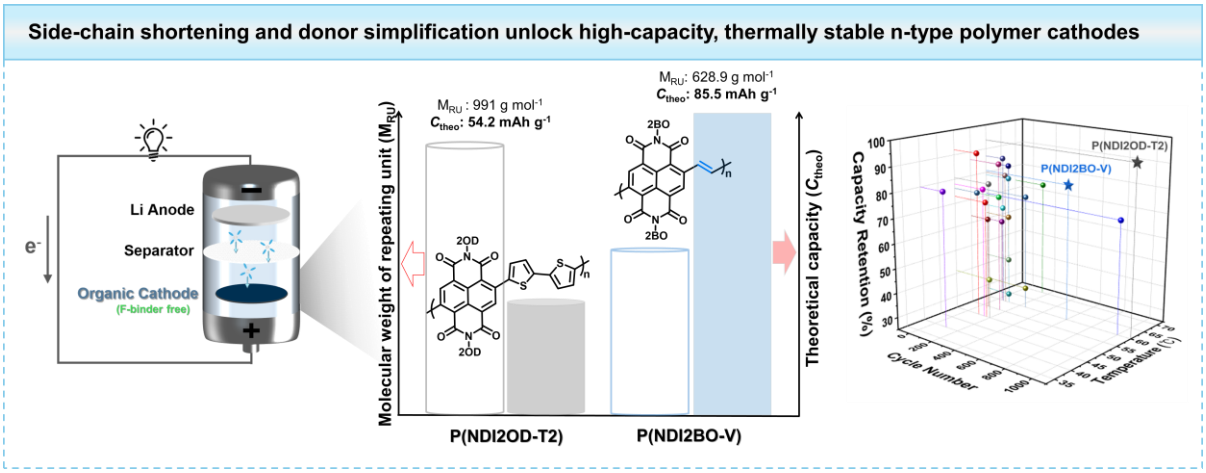


Fig. 1. NDI-based organic cathodes designed to enhance specific capacity.

[References]

(1) D. Kim, S. Kim, J. Kim, H. Ahn, C. Nam, W. Lee, *J. Power Sources*, **2025**, *631*, 236208.

(2) M. Lee, S. Kim, C. Yuk, G. Kang, E. Lee, H.-H. Cho, S. Y. Son, W. Song, T. Kim, W. Lee, *ChemSusChem*, **2025**, e202501246.

[IV 05-3]

Fabrication of Blue-Emissive Perovskite Nanocrystals by Size Control and Post-Treatment of Short Ligand

Chang-Lyoul Lee[#,*]
Advanced Photonic Research Institute (APRI), Gwangju Institute of Science and Technology (GIST), Gwangju, Korea
Email: vsepr@gist.ac.kr

Keywords: Perovskite nanocrystals, Blue-emissive, Ligand, Halide exchange, Structural stability

Halide perovskite nanocrystals (PNCs) have attracted much attention due to their excellent opto-electronic properties. The blue-emitting PNCs can be realized via either size reduction or halide exchange. Low-temperature synthesis or ligand engineering is commonly used to reduce the particle size of PNCs, resulting in blue emission. However, it increased defect density, leading to poor PLQY and structural degradation. In this study, we demonstrate that reducing the particle size of PNCs by modifying precipitation solvents enables the fabrication of highly efficient blue-emissive PNCs[1]. Additionally, halide exchange using short ligand was employed to achieve blue-emitting PNCs[2].

[References]

(1) Kim, D., Park, S. O., Park, J. S., Byeon, C. C., Lee, C. L, *Journal of Colloid and Interface Science*, **2025**, 693, 137530.

(2) D.Kim, J.S.Park, S.-Y.Yim, J-H. Lee, C-L. Lee, *Communications Engineering*, Under review.

[IV 05-4]

Next Generation NIR/SWIR Photodetectors using Organic Semiconductors

Seo-Jin Ko [#,*]
Daegu Gyeongbuk Institute of Science & Technology (DGIST),
Energy Science & Engineering, 42988, Daegu, Korea.
Emil: sjko927@dgist.ac.kr

Keywords: Organic photodetectors, NIR/SWIR, non fullerene acceptors, molecular engineering

Organic semiconductors are emerging as promising candidates for next generation near infrared (NIR) and short wave infrared (SWIR) photodetectors owing to their high absorption coefficients, tunable bandgaps, mechanical flexibility, and solution processability. Unlike conventional InGaAs or PbS systems, organic photodetectors (OPDs) can be tailored through molecular design, morphology control, and interface engineering to achieve high performance in large area and flexible formats.

Recent progress in molecular engineering, including asymmetric π bridge units, cyano functionalized acceptors, and proquinoid type non fullerene acceptors, has enabled strong NIR absorption, reduced energetic disorder, and suppressed dark current. These approaches have delivered OPDs with detectivities above 10^{12} Jones at 1000–1200 nm and external quantum efficiencies exceeding 50%. In parallel, strategies such as vertical phase segregation, planar heterojunctions, and eco friendly processing have further improved charge transport and scalability.

Organic NIR/SWIR detectors also offer unique opportunities in wearable health monitoring, bioimaging, automotive LiDAR, optical communication, and night vision applications. Their inherent flexibility and compatibility with transparent electrodes make them especially attractive for biomedical sensors and tandem integration with perovskite absorbers to achieve multi band detection.

In this contribution, we highlight recent advances in material and device design that address the key challenges of organic NIR/SWIR photodetectors, namely limited absorption range, dark current, and stability. By integrating narrow bandgap acceptors with optimized architectures, we demonstrate OPDs that rival inorganic counterparts while offering distinctive advantages in cost, flexibility, and functionality. These results underscore the strong potential of organic semiconductors for next generation optoelectronic and sensing technologies.

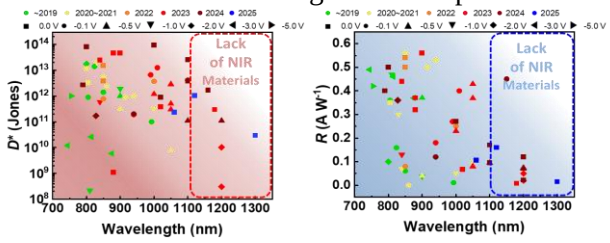


Fig. 1. Bandgap versus maximum NIR absorption map of organic semiconductors, showing the critical shortage of efficient materials for next generation NIR/SWIR photodetectors.

[References]

(1) Ko, S. J.; et al. *Adv. Optical Mater.* ***2023***, *2300312*

(2) Ko, S. J.; et al. *Adv. Funct. Mater.* **2023**, *33*, 2211486.

(3) Ko, S. J.; et al. *Chem. Eng. J.* **2024**, *490*, 151624.

(4) Ko, S. J.; et al. *Adv. Funct. Mater.* **2025**, just accepted.

[IV 05-5]

Enhancing Photovoltage and Stability in Hybrid Sn–Pb Perovskites via Integrated Interface and Growth Control

Chieh-Ting Lin[#,*]
Department of Chemical Engineering, National Chung Hsing University, Taichung, Taiwan
Email: c.lin15@nchu.edu.tw

Keywords: Tin–lead perovskite, interfacial engineering, hole transport layer, crystal growth control, stability

Tin–lead (Sn–Pb) hybrid perovskite solar cells are regarded as promising absorbers for both standalone and tandem photovoltaics because their bandgap can be tuned to capture a wider portion of the solar spectrum, including the near-infrared. Yet, these devices still fall short in efficiency and durability due to persistent problems at interfaces, uncontrolled film formation, and limited charge transport. In this study, we propose a unified strategy that tackles these aspects. At the interface, PEDOT:PSS is chemically modified through sodium hydroxide dedoping and surface texturing, which concurrently lowers recombination losses and reduces reflection. For the hole-selective layer, newly synthesized PTAA derivatives are employed to fine-tune energy alignment and facilitate hole extraction. In terms of film quality, the use of chaotropic additives such as GaSCN, enables controlled crystallization and produces uniform, defect-poor layers in lead-lean, narrow-bandgap perovskites. Devices fabricated using this approach achieve open-circuit voltages beyond 0.9 V, short-circuit currents above 32 mA cm-2, and power conversion efficiencies over 22%, while showing improved operational stability. Complementary in-situ photoluminescence, transient electrical analyses, and morphological characterization provide mechanistic understanding of how these treatments enhance performance. This work establishes a comprehensive design route for realizing efficient and stable Sn–Pb perovskite solar cells.

[IV 06-1]

Solution-processed OLEDs with high performance

Guohua Xie[a, #,*], Qin Xue[b]
[a]Institute of Flexible Electronics (IFE, Future Technologies), Future Display Institute of Xiamen, Tan Kah Kee Innovation Laboratory, Xiamen University, China.
[b]Department of Physical Science and Technology, Central China Normal University, China.
Email: ifeghxie@xmu.edu.cn

Keywords: Organic light-emitting diodes; solution process; exciton; efficiency

Organic light-emitting diodes (OLEDs) have many promising applications in smart phones, solid-state lighting, visible light communication, and medical treatment. Currently, the manufacturing of OLEDs highly relies on high-vacuum thermal evaporation, which is highly expensive and complicated. To address this issue, solution-processed OLEDs are more favorable due to the merits of large-area and low-cost mass production. In this talk, the soluble emitters featuring charge transfer characteristics and high electroluminescent efficiency will be showcased. Moreover, the state-of-the-art solution-processed OLEDs, via spin-coating, inkjet printing, and transfer printing, respectively, will be elaborated, including material design and device engineering[1-4]. In addition, the fundamental photophysics and device physics of the high-performance solution-processed OLEDs will be elucidated and unraveled.

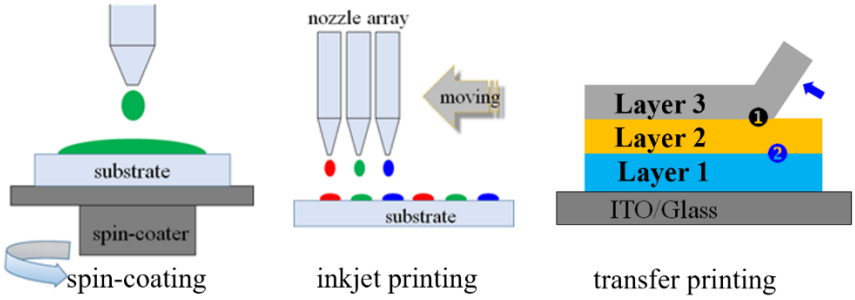


Fig. 1. Schematic diagram of OLED fabrication with different technologies.

[References]

(1) G. Xie, J. Luo, M. Huang, T. Chen, K. Wu, S. Gong, C. Yang, *Adv. Mater.* 2017, **29**, 1604223

(2) Liu, H.; Tang, Y.; Ying, A.; Gao, Y.; Chen, X.; Zhou, L.; Lin, J.; Xie, G. *Chem. Eng. J.* **2022**, *444*, 136642

(3) Y. Tang, R. Li, R. Sun, J. Min, Q. Lin, C. Yang, G. Xie, *Innovation* **2023**, *4*, 100460.

(4) C. Li, Z. Lou, M. Wu, F. Ma, X. Chen, H. Tan, Z. Liu, F. Gao, Z. Qiu, Z. Zhao, L. Hu, G. Xie, M. Li, Y. Guo, Z. Ren, S. Zhang, Y. Liu, S. Yan, Z. Li, B.o Xu, R. T. K. Kwok, J. W. Y. Lam, B. Z. Tang, *J. Am. Chem. Soc.* **2025**, *147*, 18317–18326.

[IV 06-2]

Dynamic Exciton Model: A Comprehensive ΔEST Estimation Method for TADF Materials

Youichi Tsuchiya[a,#,*] and Chihaya Adachi[a,b,c,*]
[a]OPERA, Kyushu University, 744 Motooka, Nishi, Fukuoka 819-0395, Japan.
[b]Department of Applied Chemistry, Kyushu University, 744 Motooka, Nishi, Fukuoka 819-0395, Japan.
[c]I2CNER, Kyushu University, 744 Motooka, Nishi, Fukuoka 819-0395, Japan
Email: tsuchiya@opera.kyushu-u.ac.jp, adachi@opera.kyushu-u.ac.jp

Keywords: Thermally activated delayed fluorescence, Comprehensive kinetic analysis, S-T gap estimation

The molecular design of thermally activated delayed fluorescence (TADF) materials, which are key emitters for next-generation organic light-emitting diodes (OLEDs), has been guided by quantum chemical calculations. These calculations focus on minimizing the singlet-triplet energy splitting (ΔEST) by controlling the spatial distribution of the frontier orbitals. Because reliable experimental methods for estimating ΔEST have been lacking due to methodological limitations and inherent assumptions, particularly in the near-zero-gap regime, it is difficult to evaluate the agreement between theoretical and experimental ΔEST.

We investigated TMCz-BO, a TADF material exhibiting a short exciton lifetime[1]. In toluene, TMCz-BO exhibited unusual thermal behavior in its transient emission decay. Negative activation energy for reverse intersystem crossing (RISC) and a negative ΔEST were experimentally estimated using a three-state photophysical model[2,3].

Recently, we developed an advanced experimental approach to accurately determine excitonic state energy configurations[4]. We conducted a comprehensive kinetic analysis across various solvents and temperatures using a dynamic four-state model that incorporates several basic phenomena in physical chemistry; e.g., El-Saied's rule, PLQY increasing by temperature drop and the energy stabilization of the charge-transfer excited state at low temperatures (Onsager's equation). This approach revealed detailed exciton dynamics in TMCz-BO, providing a description consistent with the typical energy configuration of TADF material (Figure 1).

In this presentation, we demonstrate the comprehensive kinetic analysis of TMCz-BO and the fine-tuning of TADF molecular design based on the experimental results. Furthermore, we will also discuss the excitonic state energy configuration of several TADF materials of interest, estimated with the dynamic four-state model.

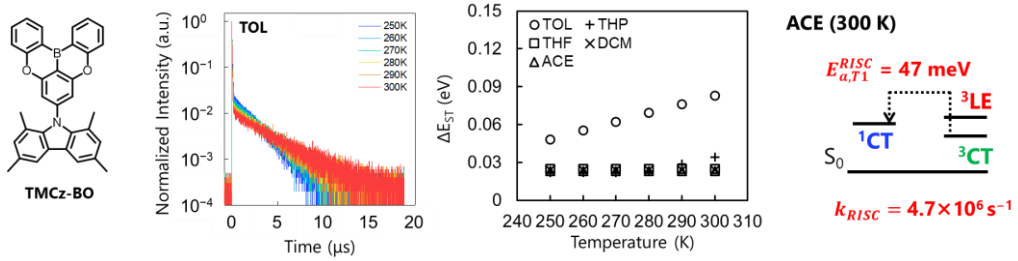


Figure 1: Summary of TADF behavior for TMCz-BO in various solvents.

[References]

(1) J.-U. Kim, I.-S. Park, C.-Y. Chan, M. Tanaka, Y. Tsuchiya, H. Nakanotani, C. Adachi, Nat. Commun., **2020**, *11*, 1765.

(2) Y. Tsuchiya, S. Diesing, F. Bencheikh, Y. Wada, P. L. dos Santos, H. Kaji, E. Zysman-Colman, I. D.W. Samuel, C. Adachi, J. Phys. Chem. A, **2021**, *36*, 8074.

(3) Y. Tsuchiya, K. Mizukoshi, M. Saigo, T. Ryu, K. Miyata, K. Onda, C. Adachi, Faraday Discuss., **2024**, *250*, 233.

(4) Y. Tsuchiya, K. Mizukoshi, M. Saigo, T. Ryu, K. Miyata, K. Onda, C. Adachi, Nat. Commun. **2025**, *16*, 4815.

[IV 06-3]

Synergistic Additive and Interface Engineering for High-Efficiency and Stable Inverted Perovskite Solar Cells

Fuqiang Li, Xiangrui Du, Sung Heum Park*
Department of Physics, Pukyong National University, Busan 48513, Republic of Korea.
Email: spark@pknu.ac.kr

Keywords: Perovskite Solar Cells, Defect Passivation, Halide perovskite, covalent organic framework, additives.

Achieving high-quality perovskite films with minimal surface defects remains a critical challenge in the development of high-efficiency and stable perovskite solar cells (PSCs). In this study, we investigated the effect of functional additives on perovskite crystallization and defect passivation. Specifically, the incorporation of 4-tert-butylammonium iodide (4-TBA) into the precursor solution led to notable improvements in both optoelectronic properties and film morphology. Methylammonium (MA)-based inverted PSCs exhibited a substantial increase in power conversion efficiency (PCE) from 16.15% to 19.25%, while CsFAMA-based devices demonstrated an enhancement from 19.70% to 23.01% upon 4-TBA addition. Moreover, the treated devices showed significantly improved resistance to moisture and thermal stress, resulting in enhanced long-term stability. In a complementary approach, we introduced a covalent organic framework (COF)-templated self-assembly method to optimize the hole-selective layer (HSL) interface. By pre-depositing imine-linked COF (ILCOF) nanosheets on ITO substrates, we effectively modulated the interfacial morphology of [2-(3,6-dimethoxy-9H-carbazol-9-yl)ethyl]phosphonic acid (MeO-2PACz) self-assembled monolayers. This templated surface engineering not only improved the molecular ordering of the HSL but also contributed to improved charge extraction and thermal robustness. Together, these dual strategies—additive-assisted bulk crystallization and COF-guided interface optimization—synergistically contribute to the realization of high-performance PSCs with superior efficiency and long-term operational stability.

[IV 06-4]

Toward High-Performance Perovskite Solar Cells Based on Organic Materials Chemistry

Toshinori Matsushima[#,*]
International Institute for Carbon-Neutral Energy Research (I2CNER), Kyushu University,
744 Motooka, Nishi, Fukuoka 819-0395, Japan
Email: tmatusim@i2cner.kyushu-u.ac.jp

Keywords: perovskite solar cell; organic molecules; defect passivation; hole transport; durability

Perovskite solar cells (PSCs) have rapidly emerged as one of the most promising next-generation photovoltaic technologies, combining high efficiency with low-cost solution processing. Nevertheless, the presence of intrinsic defects in perovskite films, unstable interfaces, and insufficient operational durability remain critical barriers for commercialization. Organic functional materials provide versatile and powerful tools to overcome these challenges. In particular, organic defect passivation agents, self-assembled monolayers (SAMs), and organic hole transport layers (HTLs) have proven indispensable in addressing nonradiative losses, enhancing interfacial contact, and improving long-term stability.

Organic defect passivation molecules target one of the most detrimental aspects of perovskites: the high density of trap states arising from halide vacancies, undercoordinated Pb2+ centers, and grain boundaries. By coordinating with these defect sites through functional groups such as amines, carboxyls, thiols, or phosphonic acids, organic molecules suppress trap-assisted recombination and extend carrier lifetimes. Beyond electronic passivation, many organic molecules also impart hydrophobicity, shielding the perovskite from ambient moisture, while their intrinsic dipole moments can modulate band alignment to facilitate efficient charge extraction.

SAMs have emerged as another highly effective interfacial engineering strategy. When deposited on conductive oxides such as ITO or SnO2, SAMs form ordered molecular monolayers that not only passivate interface defects but also provide tunable work function alignment between the electrode and the perovskite. This controlled surface chemistry promotes uniform nucleation and crystal growth of perovskite layers, yielding smooth, large-grained films with reduced boundary density. Importantly, the molecular design of SAMs can also exploit π–π stacking interactions, which enhance intermolecular ordering and facilitate charge transport across the interface, thereby improving device reproducibility and long-term reliability.

Organic HTLs have long played a central role in PSC device design. Molecules such as spiro-OMeTAD, triphenylamine derivatives, and dopant-free alternatives provide efficient hole extraction, while simultaneously blocking electron transport. Through rational design, incorporation of heteroatoms, and tailored substituents, modern HTLs demonstrate improved film morphology, optimized energy levels, and enhanced resistance to dopant migration and moisture uptake. In addition, π–π interactions within HTL frameworks contribute to coherent molecular packing and efficient hole transport, while the stability of radical cations formed upon oxidation is crucial for ensuring reliable long-term conductivity. Designing HTLs with substituents that stabilize oxidized species suppresses degradation pathways and enhances operational durability. Their inherent flexibility and solution processability further make organic HTLs highly suitable for tandem cells and flexible device architectures.

When integrated together, these organic strategies act synergistically. Defect passivation molecules mitigate bulk and surface traps, SAMs engineer well-defined and electronically favorable interfaces strengthened by π–π ordering, and organic HTLs ensure selective charge extraction with stable radical cation states. This holistic approach not only reduces nonradiative recombination and enhances open-circuit voltage, but also strengthens resistance against thermal, electrical, and environmental stressors. As a result, PSCs that incorporate a combination of organic defect passivation, SAMs, and advanced organic HTLs have achieved both record-high efficiencies and remarkable operational lifetimes.

Thus, the deliberate integration of these organic materials establishes a comprehensive framework for advancing PSC technology, demonstrating that the synergy of molecular passivation, interfacial monolayers, and HTLs—together with π–π interactions and radical cation stability—can deliver perovskite solar cells with simultaneously high efficiency and long-term stability.

[IV 06-5]

Tailored Electrical Doping in Perovskite Electronics

Keehoon Kang[#,*]
Department of Materials Science and Engineering, Seoul National University, Seoul, Korea
E-mail: keehoon.kang@snu.ac.kr

Doping has been one of the most essential methods to control charge carrier concentration in semiconductors. Excess generation of charge carriers is a key route for controlling electrical properties of semiconducting materials which has played pivotal roles in making breakthroughs in microelectronic and optoelectronic devices. In metal halide perovskite (MHP), which have revolutionized the field of solar cells and light-emitting diodes due to their favorable optoelectrical properties, extensive electrical doping via conventional substitutional doping still remains challenging due to their structural stability limited by tolerance factor and compensation of intentionally introduced defects by mobile halide ions. In this talk, I will introduce our recent works in understanding the fundamentals of doping in MHPs, in addition to the novel doping techniques that we have developed to achieve dopant incorporation into the bulk crystal for tailoring their electrical properties. Our efficient doping methods developed will open up a controllable route towards tuning electronic structure for optimizing and functionalising perovskite-based electronic and optoelectronic devices.

[Poster 01-1]

Two-Stage Polymerization Integrates Donor Optimization for Efficient Visible-Light Photocatalytic H_2 Generation

Wootaek Jung[a], Sanghyeok An[a, #,] Gayoung Ham[b], Chanhyeok Kim[a], Soyeon Lee[c], Jiwoong Yang[c], Dae Sung Chung[a,*], Hyojung Cha[b,*], Taiho Park[a,*]
[a]Department of Chemical Engineering, Pohang University of Science and Technology, 77 Cheongam-Ro, Nam-Gu, Pohang, Gyeongbuk, 37673, Korea
[b]School of Energy Engineering, Kyungpook National University, Daehak-Ro 80, Buk-gu, Daegu 41566, Republic of Korea.
[c]Department of Energy Science & Engineering, Chemical Engineering Track,
Email: dchung@postech.ac.kr

Keywords: Photocatalysts, Hydrogen Evolution, Conjugated Polymer, Suzuki Polymerization.

We report BT-based conjugated polymers engineered with varying loadings of the strong donor 4,8-bis(5-(2-ethylhexyl)thiophen-2-yl)benzo[1,2-b:4,5-b′]dithiophene (BDT) to advance visible-light hydrogen evolution. The polymers were processed into polymer dots (Pdots) by nanoprecipitation to create dispersible photocatalysts. Among the series, an optimized composition, PBF8BT-2, achieved a hydrogen evolution rate (HER) of 22,134 μmol g^{-1} h^{-1} under $\lambda > 420$ nm irradiation with 8 wt% Pt cocatalyst, nearly doubling the activity of the F8BT reference. Time-resolved photoluminescence and transient absorption spectroscopy show that BDT incorporation promotes more efficient charge separation, prolongs charge-carrier lifetimes, and suppresses non-radiative recombination. Density functional theory further indicates that BDT induces a more planar polymer backbone, strengthening π–π stacking and enhancing charge delocalization. These structural and photophysical effects improve light harvesting and catalytic turnover in the Pdot state. The synthetic approach—tuning donor content through straightforward polymer design and translating the materials into Pdots—offers a scalable route that leverages design logic from organic photovoltaics for photocatalytic hydrogen production. Overall, this study clarifies how donor–acceptor interplay governs excited-state dynamics and charge transport in polymer photocatalysts, providing actionable design rules for next-generation, visible-light-driven hydrogen evolution systems.

[References]

(1) W. Jung, S. An, G. Ham, C. Kim, S. Lee, J. Yang, D. S. Chung, H. Cha, T. Park, *EES Catal.* **2025**, *3*, 775.

[Poster 01-2]

Ligand–Polymer Crosslinked Architectures Enabling Robust PbS Quantum Dot Photodetectors in the SWIR Region

Kyobin Park[a,#], Sangjun Lee[a], Syed Zahid Hassan[a], Chan So[a], and Dae Sung Chung[a,*]
[a]Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH)
Email: dchung@postech.ac.kr

Keywords: PbS Quantum dot, Organic Photodetector, Shortwave Infrared (SWIR), Azide functional dithiolene ligand, Photo-crosslinking

Colloidal lead sulfide (PbS) quantum dots (QDs) represent a cost-effective candidate for short-wave infrared (SWIR) photodetectors extending beyond 1500 nm, offering a scalable alternative to epitaxially grown InGaAs. Yet, the enlarged nanocrystal dimensions required to access long-wavelength absorption predominantly expose (100) facets with limited dangling bonds, which fundamentally hinders conventional surface passivation. This limitation manifests as pronounced trap-assisted dark currents and poor operational stability. To address this, we present a hybrid diode configuration in which PbS QDs are functionalized with a specially engineered dithiolane azide ligand. Upon film deposition, these ligands undergo photochemical crosslinking with both p-type (P3HT) and n-type (N2200) semiconducting polymers, forming robust covalent linkages that tightly integrate the QDs into the surrounding polymeric matrix. This crosslinked network provides uniform encapsulation and effectively mitigates the intrinsic passivation challenges of large QDs. Devices fabricated through this approach achieve external quantum efficiencies surpassing 80% at 1600 nm, dark currents suppressed to 20 nA/cm² at −0.5 V, and breakdown voltages exceeding −20 V. Trap-state analysis reveals an order-of-magnitude reduction in defect density relative to non-crosslinked counterparts. In addition, the photodiodes exhibit detectivities above 10^{12} Jones, a linear dynamic range greater than 160 dB, and stable performance under prolonged electrical stress. Finally, the solution-processed architecture is directly integrated onto silicon CMOS wafers via spin-coating, enabling high-resolution SWIR imaging. These findings highlight ligand–polymer crosslinking as a versatile strategy for achieving fully passivated, high-performance QD-based infrared detectors, paving the way for scalable next-generation imaging platforms.

[References]

(1) H. Wang, J. Pinna, D. G. Romero, L. Di Mario, R. M. Koushki, M. Kot, G. Portale, M. A. Loi, *Adv. Mater*, **2024**, *36*, 2311526

(2) V. Pejović, E. Georgitzikis, I. Lieberman, P. E. Malinowski, P. Heremans, D. Cheyns *Adv. Mater*, **2022**, *32*, 2201424.

[Poster 01-3]

Molecular Structure Design of Polymer-based Organic Cathodes for Enhanced Capacity and Durable High-temperature Stability

Soyoung Kim[a,#], Wonho Lee[a,*]
[a]Department of Polymer Science and Engineering, Kumho National Institute of Technology, Gumi, Korea
Email: 1holee@kumoh.ac.kr

Keywords: Lithium-ion batteries, organic cathode, polymer, molecular structure modification.

Lithium-ion batteries (LIBs) have become the most widely used energy storage technology in portable electronics, electric vehicles, and large-scale energy storage systems owing to their high energy density and long cycle life. However, conventional inorganic cathode materials (e.g., layered oxides and phosphates) face critical challenges such as resource scarcity, high cost, structural instability, and safety issues at elevated temperatures. To overcome these limitations, organic cathode materials have recently emerged as a promising sustainable alternative.1 Among them, polymer-based organic cathodes offer unique advantages, including structural tunability, lightweight composition, environmental friendliness, and potential for low-cost mass production. Unlike small-molecule organics, polymers can suppress dissolution in electrolytes, thereby enhancing cycling stability. Furthermore, precise molecular design of conjugated backbones and redox-active moieties enables simultaneous improvement of capacity, cycling stability, and high-temperature performance. For example, N2200 polymer-based cathodes have demonstrated outstanding stability over 3000 cycles, but their capacity remains limited to 52.4 mAh g^{-1}.2, 3 In this work, we designed and synthesized new molecular structures to enhance the theoretical capacity of N2200-based polymers. In addition to capacity improvement, our design also aims to mitigate performance degradation under thermal stress during battery operation, thereby achieving superior high-temperature cycling stability.

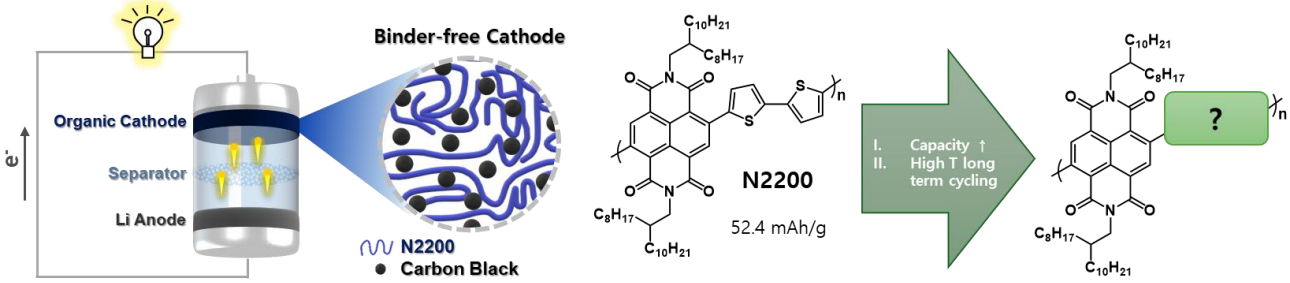


Fig. 1. Development of new polymers through molecular structure engineering of N2200 for improved capacity and long-term cycling stability at high temperatures.

[References]

(1) Baskoro, F.; Sharma, S. U.; Lubis, A. L.; Yen, H.-J. *J. Mater. Chem. A* **2025**, *13* (3), 1552– 1589

(2) D. Kim, S. Kim, J. Kim, H. Ahn, C. Nam, W. Lee, *J. Power Sources* 2025, **631**, 236208.

(3) Liang, Y.; Chen, Z.; Jing, Y.; Rong, Y.; Facchetti, A.; Yao, Y. *J. Am. Chem. Soc.* **2015**, *137*, 4956– 4959

[Poster 01-4]

Shortwave Infrared Organic Photodiodes Achieving High Performance via Polaron Absorption in Doped Polymers

Sangjun Lee[a,#], Dae Sung Chung[a,*]
[a]Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, 37673, Republic of Korea
Email: dchung@postech.ac.kr

Keywords: Shortwave Infrared (SWIR), Organic Photodiodes (OPDs), Polaron, Doping

This study introduces an innovative strategy for shortwave infrared (SWIR) organic photodiodes (OPDs) using doped polymers, addressing long-standing barriers of limited absorption range in conjugated molecules and elevated dark currents in SWIR-absorbing materials. We demonstrate a distinct detection mechanism based on light-induced conversion of bound to free polarons. By engineering the doping process and enabling dopant diffusion into the crystalline domains of the polymer matrix, we maximize both bound-polaron density and the bound-to-free polaron ratio, directly enhancing device performance. Advanced characterization, including 2D grazing-incidence X-ray diffraction and Fourier-transform infrared spectroscopy, verifies precise dopant placement, while temperature-dependent conductivity and electron spin resonance measurements establish a strong correlation between polaron conversion and improved photoconductivity. The optimized double-doped OPD delivers an external quantum efficiency of 77,100% and a specific detectivity of 1.11×10^{11} Jones. Furthermore, by reducing the spatial separation between polymer chains and dopant anions, Coulombic interactions are reinforced, fostering higher polaron densities and improved device efficiency. These findings validate polaron absorption as a compelling alternative to Frenkel excitons for SWIR photodetection and establish a new design paradigm for organic optoelectronic devices, with broad potential in advanced sensing and imaging applications.

[Poster 01-5]

Enhancing thermal stability of organic solar cells via active layer crosslinking with azide-functionalized additives

Yejin Lee[a,#], Soyoung Kima, Wonho Lee[a,*]
[a]Department of Polymer Science and Engineering, Kumho National Institute of Technology, Gumi, Korea
Email: 1holee@kumoh.ac.kr

Keywords: organic solar cells, thermal stability, electrode diffusion, azide crosslinker

Organic solar cells (OSCs) are getting a lot of attention because they are lightweight, flexible, affordable, and can convert sunlight into electricity efficiently. Thanks to recent progress, their power conversion efficiency (PCE) has now gone over 20%, which makes them more suitable for everyday use. However, OSCs still have problems with stability when exposed to things like heat, light, oxygen, and moisture. Among these, heat is especially harmful because high temperatures can change the material structure and cause chemical damage. Our research group is studying how heat causes OSCs to lose performance.1,2 One major problem is that metal layers on top of the device, such as MoO_3 and silver (Ag), can move into the active layer when the device gets hot. This movement creates defects, blocks the flow of electric charges, and leads to faster device failure. To help solve this issue, we suggest adding special material with azide groups to the active layer. When exposed to UV light, this material reacts and forms strong chemical bonds, creating a tightly connected network.3 This network is expected to make the layer stronger and more stable, preventing metal from moving into it and keeping the structure from changing too much. This idea is based on earlier research that showed making the active layer more compact and stable can help improve the device's durability. We are following a similar approach to previous studies that used crosslinking to stop damage from heat and metal movement. We plan to test how well this method works to keep the device stable under heat in future experiments. In summary, this strategy offers a simple and practical way to improve how long OSCs can last by making their inner structure stronger. It can also work together with other design methods and help accelerate the commercialization of organic solar cells.

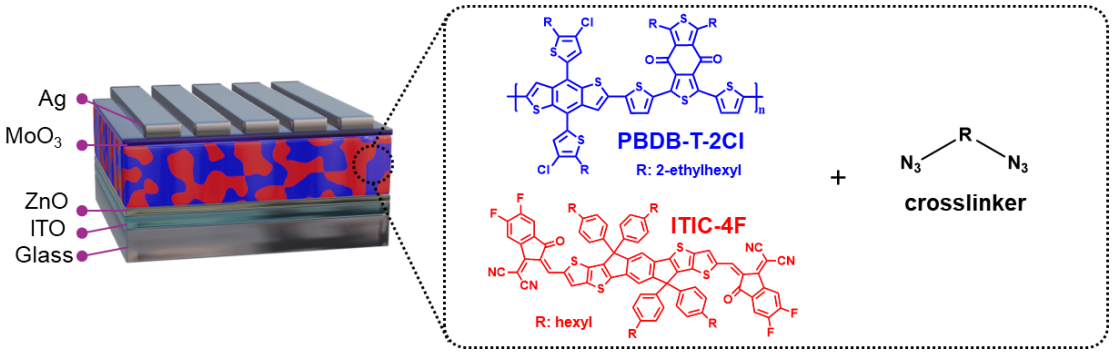


Fig. 1. Chemical structures of the PBDB-T-2Cl polymer donor, the ITIC-4F acceptor and azide crosslinker

[References]

(1) D. Lee, Y. Jang, J. Kim, S. Y. Jeong, H. Y. Woo, D. Lee, J. Kim, Y. Lee, C. Lee, W. Lee, *J. Mater. Chem. A* 2023, **11**, 3008–3017.

(2) Jang, Y.; Son, H.; Kim, S.; Lee, D.; Hwang, J. H.; Kim, H.; Kim, J.; Chang, S.-J.; Ahn, H.; Lee, D. et al. *Chem. Eng. J.* **2024**, *500*, 157083

(2) Kim, H.; Heo, Y.; Na, Y.; Shafian, S.; Kim, B.; Kim, K. *ACS Appl. Mater. Interfaces* **2024**, *16* (41), 55873– 55880

[Poster 01-6]

Challenges and Approaches in Short-Wave Infrared Organic Photodiode Design

Chan So[a,#], Daesung Chung[a,*]
[a]Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, 37673, Republic of Korea
Email: dchung@postech.ac.kr

Keywords: SWIR, organic photodetector**.**

Organic photodiodes (OPDs) are emerging as promising candidates for next-generation optoelectronic devices due to their mechanical flexibility, lightweight nature, and compatibility with low-cost solution processing. Among their many applications, short-wave infrared (SWIR) detection has received particular interest because of its importance in imaging, sensing, and transparent device technologies. However, a central challenge in extending OPD sensitivity into the SWIR region lies in the fundamental trade-off between achieving long-wavelength absorption and maintaining efficient charge separation.

In many molecular systems, long-wavelength absorption is realized through strong intramolecular charge transfer (ICT) transitions. While this strategy effectively red-shifts the absorption spectrum, it often results in increased electronic localization, thereby hindering exciton dissociation and charge transport. As a result, devices based solely on ICT-driven materials frequently suffer from limited responsivity and high noise levels. This intrinsic limitation highlights the need for alternative design philosophies that can decouple absorption from detrimental charge localization.

Two conceptual approaches are proposed to address this issue. The first emphasizes the rational control of ICT characteristics to balance absorption and electronic delocalization. By suppressing excessive localization while retaining sufficient charge transfer character, it may be possible to preserve both strong absorption and efficient charge separation. The second approach explores fundamentally new mechanisms to induce long-wavelength absorption beyond conventional molecular design. Electrochemical or external doping strategies, for example, offer pathways to generate additional electronic states that extend spectral coverage while simultaneously facilitating improved carrier dynamics.

Together, these strategies illustrate a broader principle: successful SWIR OPD development requires not only pushing the absorption edge but also ensuring that exciton dissociation and charge collection remain efficient. Rather than relying exclusively on molecular structures optimized for ICT, the field may benefit from hybrid approaches that combine material engineering with controlled external modulation of electronic states.

In summary, this work underscores the importance of addressing the inherent trade-off between absorption and charge separation in SWIR OPDs. By rethinking how long-wavelength sensitivity is achieved, it is possible to envision organic photodetectors that match or surpass conventional technologies in both spectral coverage and operational efficiency.

[Poster 01-7]

Polymer-Based Spherical Optoelectronic Devices Enabled by Gyroscopic Deposition

Taekmin Kim[a,#], So Chan[a], and Dae Sung Chung[a,*]
[a]Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, 37673, Republic of Korea
Email: dchung@postech.ac.kr

Keywords: Gyroscopic Deposition, Spherical Optoelectronics, Wide-angle Photodetection

Advancing polymer electronics into unconventional geometries offers new opportunities for both energy harvesting and sensing technologies. While organic semiconductors have been extensively studied in planar device configurations, their performance often deteriorates under angled light incidence, limiting practical applications. To address this challenge, we developed a fabrication strategy that combines polymer-based active materials with a gyroscopic thin-film deposition technique, enabling uniform coating over fully spherical substrates. This approach allowed the realization of spherical organic solar cells and photodiodes with stable multilayer architectures. The spherical geometry significantly broadens the angular response window, maintaining photocurrent generation across diverse incidence angles. Moreover, by introducing pixelation strategies, spherical photodiodes demonstrate the capability of directional light tracing, highlighting potential use in biomimetic sensor systems. Our findings underline how polymer materials, when integrated with novel deposition strategies, can transcend conventional device architectures. This study provides a platform for spherical optoelectronics that harness the intrinsic flexibility of organic semiconductors, paving the way for innovative applications in wide-angle light harvesting and bio-inspired polymeric sensors.

[Poster 01-8]

Dual-Interface Engineering of the Source Electrode in Organic Schottky Barrier Transistors for a Record On/Off Ratio

Hye Ryun Sim[a,#], Sangjun Lee[a], Geon-Hee Nam[a], Jieun Kwon[a], Junseo Kim[a], Syed Zahid Hassan[a], Dae Sung Chung[a,*]
[a]Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, 37673, Republic of Korea
Email: dchung@postech.ac.kr

Keywords: organic Schottky barrier transistor, organic vertical transistor, Schottky barrier, contact resistance, doping

Organic Schottky barrier transistors (OSBTs) adopt a straightforward vertical configuration, where the effective channel length is determined by the thickness of the semiconductor film. A key limitation arises from the source/semiconductor Schottky barrier: reducing its height enhances charge injection and boosts the on-current, but simultaneously increases leakage; conversely, raising the barrier suppresses leakage at the expense of current injection. In this work, we disentangle these conflicting requirements through a dual-interface strategy that integrates a patterned charge injection layer beneath the source contact together with a self-assembled monolayer (SAM) on its surface. The injection layer—P3HT doped with F4TCNQ—is defined selectively by oxygen reactive ion etching (RIE), where the Ag nanowire (AgNW) electrode itself acts as the etch mask. This locally doped interface minimizes contact resistance and promotes efficient hole injection under negative gate bias. At the same time, a 1-hexadecanethiol (HDT) SAM deposited on the AgNW surface increases the barrier height, effectively reducing off-state leakage. With this dual modification, the devices achieve an on-current of 3.43×10-5 A and record-high on/off ratio of 3.38×107, while also maintaining long-term operational stability. This approach resolves the fundamental performance trade-off of OSBTs and offers a broadly applicable route toward high-performance organic vertical transistors.

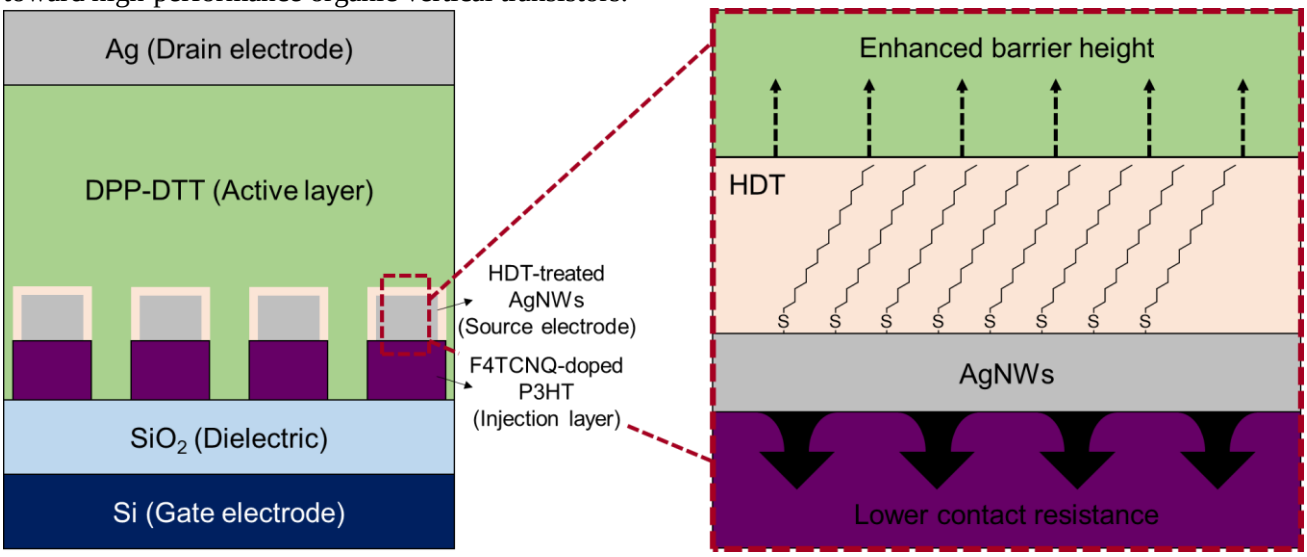


Fig. 1. Schematic diagram of the OSBT device with the charge injection layer and HDT-treated AgNWs, with the dashed line illustrating the roles of each layer.

[Poster 01-9]

Robustly Doped Proquinoidal-Based Conjugated Polymers for Direct Short-Wave Infrared Photothermoelectric Devices and Detectors

Guan-Lin Chen[a,#], Soonyong Lee[b], Han Young Woo[b,*], Cheng-Liang Liu[a,*]
[a]Department of Materials Science and Engineering, National Taiwan University, Taipei 10617, Taiwan.
[b]Department of Chemistry, College of Science, Korea University, 136-713 Seoul, Republic of Korea.
Email: liucl@ntu.edu.tw

Keywords: proquinoidal, open-shell properties, short-wave infrared, photodetector, photothermoelectric

Photothermoelectric (PTE) conversion offers a promising route for converting light into electricity.[1-3] However, the short-wave infrared (SWIR) region, which represents about one-third of solar energy, remains largely untapped for detection and practical applications. Here, benzo[c][1,2,5]thiadiazole (BT) and proquinoidal benzo[1,2-c:4,5-c']bis[1,2,5]thiadiazole (BBT) units were copolymerized with terthiophene to yield PBT2T-T and PBBT2T-T. PBBT2T-T exhibits pronounced open-shell character, enabling absorption from the visible to the SWIR region. Vapor doping with F4TCNQ increased the conductivity of doped PBBT2T-T nearly 5000-fold over doped PBT2T-T, attributable to its preferential face-on molecular orientation, which facilitates efficient doping. The thermoelectric power factor of doped PBBT2T-T reached 22.4 μW m-1 K-2, retaining 85% after 384 h at 25 °C and 40% relative humidity (RH). Under 50 mW/cm2 SWIR illumination at 40% RH, photodetectors based on doped PBBT2T-T exhibited a responsivity of 0.01047 V/W and a specific detectivity of 1.38 × 106 Jones, remaining stable over 100 on/off cycles. PTE devices based on doped PBBT2T-T showed an open-circuit voltage of 215.6 mV, short-circuit current of 1.38 μA, and output power of 0.15 nW, maintaining stability under 36,000 s of continuous illumination. These results establish a new paradigm for photothermoelectric materials in direct SWIR detection and energy conversion.

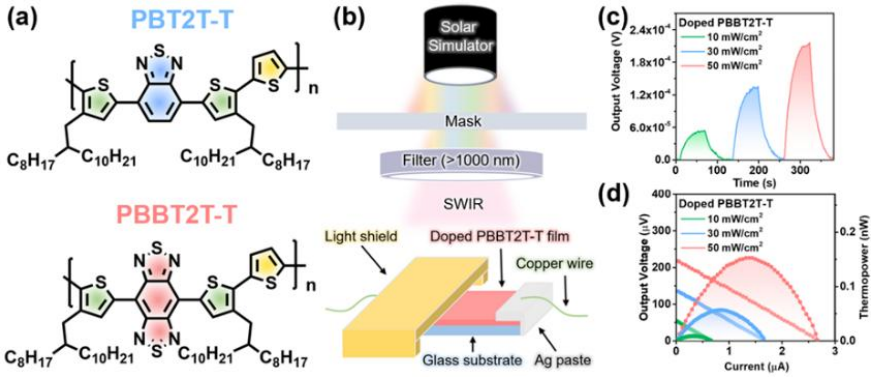


Fig. 1. (a) Chemical structures of PBT2T-T and PBBT2T-T. (b) Schematic illustration of the direct SWIR detector and photothermoelectric device. (c) Output voltage as a function of SWIR light intensity. (d) Output voltage, current, and thermopower at various SWIR light intensities.

[References]

(1) Zhang, Q.; Huang, A.; Ai, X.; Liao, J.; Song, Q.; Reith, H.; Cao, X.; Fang, Y.; Schierning, G.; Nielsch, K.; Bai, S.; Chen, L. *Adv. Energy Mater*. **2021**, *11*, 2101213.

(2) Huang, Q.; Ye, X.; Chen, W.; Song, X.; Chen, Y.-t.; Wen, X.; Zhang, M.; Wang, Y.; Chen, S.-L.; Dang, L.; Li, M.-D. *ACS Energy Lett*. **2023**, *8*, 4179−4185.

(3) Kim, B.; Shin, H.; Park, T.; Lim, H.; Kim, E. *Adv. Mater*. **2013**, *25*, 5483.

[Poster 01-10]

Structural Design of 2D Dion-Jacobson Tin Perovskites via Alkyl Chain Spacer Modulation for Efficient Charge-Transporting Semiconductors

Wantae Park[a,#], Mingoo Kwon[a], Dong Hyeon Lee[a], Soohwan Yoo[a], Wonryeol Yang[a], Ji-Sang Park[b,*], Ao Liu[c], Youjin Reo[a,*], Huihui Zhu[d,*], and Yong-Young Noh[a,*]

[a] Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, Gyeongbuk, 37673, Republic of Korea

[b] SKKU Advanced Institute of Nanotechnology(SAINT), Sungkyunkwan University, Suwon 16419, Republic of Korea

[c] Institute of Fundamental and Frontier Sciences, State Key Laboratory of Electronic Thin Films and Integrated Devices, Key Laboratory of Quantum Physics and Photonic Quantum Information of the Ministry of Education, University of Electronic Science and Technology of China, Chengdu 611731, China

[d] School of Physics, University of Electronic Science and Technology of China, Chengdu 611731, China

Email: yynoh@postech.ac.kr

Keywords: two-dimensional tin-based Dion-Jacobson perovskites, odd-even effect, field-effect transistor

Two-dimensional (2D) tin (Sn^{2+})-based perovskites have emerged as promising p-type semiconducting materials for(opto)electronic devices due to their favorable balance of electrical performance and structural stability.1 While previous studies on 2D perovskites predominantly investigated Ruddlesden−Popper (RP)perovskites with monoammonium spacers, Dion−Jacobson (DJ)perovskites with diammonium spacers have recently sparked attention in the research community.2 The strong hydrogen bonds at both ends of the diammonium spacer, connecting neighboring inorganic octahedral layers, promote structural stability and efficient charge transport in DJ perovskites. This study systematically investigates a series of 2D DJ Sn^{2+} perovskites, [(H_3N)-(CH_2)m-$(NH)_3SnI_4$] (m = 3−8), to explore the influence of the length of spacer chains on lattice structures, film crystallinity, and charge transport properties. Our findings reveal that DJ perovskites with even-numbered chains (m = 4, 6, 8) exhibit well-ordered layered structures, whereas those with odd-numbered chains (m = 3, 5, 7) disrupt the formation of 2D structures. Furthermore, we reveal that the precursor stoichiometry can govern the phase evolution along with the role of spacer parity. Among the even-numbered 2D DJ Sn2+ perovskites, 1,4-butanediammonium tin iodide (BDASnI4, m = 4) exhibits optimal lattice formation and superior charge transport properties. Moreover, the introduction of an additional self-assembly monolayer ([2-(3,6-diiodo-9H-carbazol-9-yl)ethyl]phosphonic acid, I-2PACz) between the dielectric and channel layers further enhances the interface quality and reduces the trap density. The optimized transistor exhibits significantly reduced hysteresis and boosted field-effect mobility up to 1.45 cm2 V^{-1} s^{-1}.

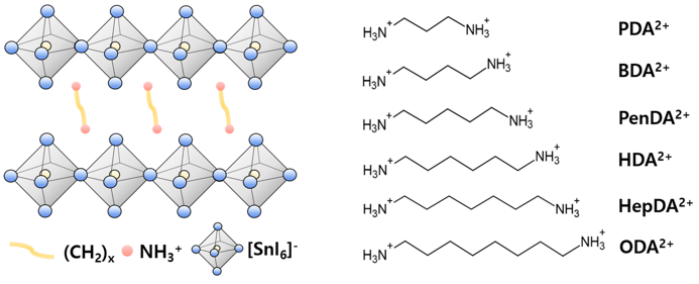


Fig. 1. Schematics of 2D Sn2+ DJPs based on linear diammonium spacers with increasing chain lengths.

[References]

(1) Yang, X.; Liu, Y.; Yang, S.; Wu, Y.; Lei, Y.; Yang, Y.; Liu, A.; Chu, J.; Li, W. *Adv. Funct. Mater*. **2024**, *34* (40), 2403917.

(2) Niu, T.; Xue, Q.; Yip, H.-L. *Nanophotonics* **2021**, *10* (8), 2069-2102.

[Poster 01-11]

A Chloride-Based Crystallinity Control Strategy for High-Performance 2D Tin Halide Perovskite Transistors

Hyoungha Ryu[a,#], Youjin Reo[a,*], Wantae Park[a] , Donghyeon Lee[a] , Hamin Choi[a], Soohwan Yoo[a], Ao Liu[b], HuiHui Zhu[c,*], Yong-Young Noh[a,*]

[a] Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, Gyeongbuk 37673, Republic of Korea

[b]Institute of Fundamental and Frontier Sciences, State Key Laboratory of Electronic Thin Films and Integrated Devices, Key Laboratory of Quantum Physics and Photonic Quantum Information of the Ministry of Education, University of Electronic Science and Technology of China, Chengdu 611731, China

[c]School of Physics, University of Electronic Science and Technology of China, Chengdu 611731, China

Email: yynoh@postech.ac.kr

Keywords: Tin halide perovskites, additive engineering, thin film transistors, crystallization

Tin (Sn^{2+})-based halide perovskites have emerged as promising lead-free alternatives for high-performance thin film transistors (TFTs) due to their low toxicity and excellent hole transport properties. However, difficult control over their rapid film crystallization hinders the device performance and yield. In this study, we demonstrate that the incorporation of chloride additives, particularly methylammonium chloride (MACl), into phenethylammonium tin iodide (PEA2SnI4) effectively modulates the crystallization process by forming intermediate complexes within the precursor solution and the film, fabricating large crystallites with minimized defects. The enhanced film quality contributes to efficient charge transport in the channel layers of TFT, where optimized MACl-PEA2SnI4 TFTs exhibit up to a three-fold increase in field-effect mobility and a substantial enhancement in the on/off current ratio. The chloride additive engineering can effectively address the fundamental issues of rapid crystallization in Sn2+-based perovskites, providing deeper insights into efficient film quality modulation and charge transport efficiency for electronic applications.

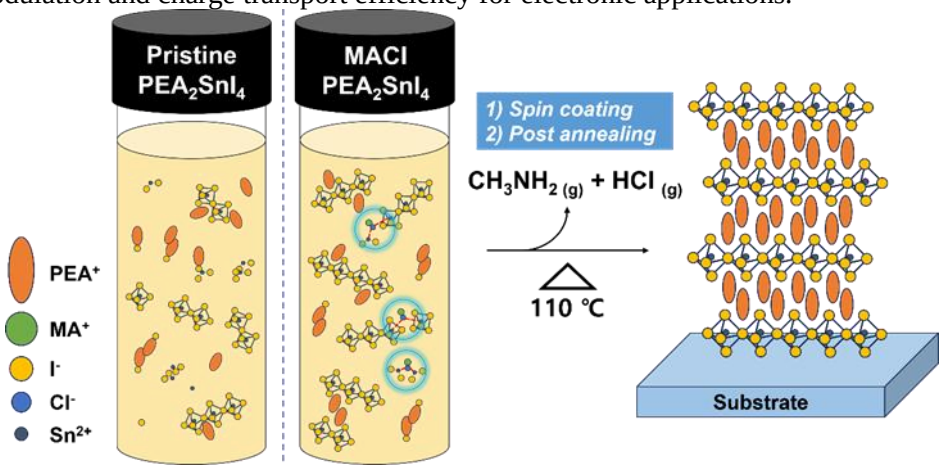


Fig. 1. Schematic diagram of MACl-octahedral crystallite intermediate complexes and their effect on large sized, highly crystalline grain growth

[Poster 01-12]

Retarding Degradation of Perovskite Thin Film with Lead Bication Thiocyanate Salt

Siwon Yun [a,#], Mi-Seon Bae [b], Muhammad Adnan [a], Zobia Irshad [a], Wonjong Lee [a], Hyeji Han [a], Tae-Youl Yang [b]*, Hyo Sik Chang [a]*, Jinseck Kim[c]*, and Jongchul Lim [a]*

[a] Graduate School of Energy Science and Technology (GEST), Chungnam National University Daejeon, 34134, Republic of Korea

[b]Department of Materials Science and Engineering, Chungnam National University, Daejeon 34134, Republic of Korea

[c]Department of Polymer-Nano Science and Technology, Department of Nano Convergence Engineering, Jeonbuk National University, Jeonju, 54896, Republic of Korea

Email: jclim@cnu.ac.kr

Keywords: stability of perovskite, additives, fabrication, perovskite thin film, perovskite analysis

Organic-inorganic lead halide perovskites have emerged as frontrunners in next-generation optoelectronic technologies due to their exceptional optoelectronic properties. Despite remarkable advancements, their commercialization is hindered by poor intrinsic stability and suboptimal charge-carrier dynamics. In this work, we introduced thionate-based additives, 1-butyl-3-methylimidazolium thiocyanate (BMIM-SCN) and 1-butyl-3-methylimidazolium lead thiocyanate (BMIM-Pb(SCN)3), as effective chemical modulators to simultaneously enhance the crystallinity, surface quality, and environmental resilience of hybrid perovskite films. Incorporation of these additives facilitates the formation of dense, uniform crystal grains with improved surface coverage and significantly reduced surficial and interfacial trap states. The modified films exhibit superior charge transport behavior and demonstrate remarkable resilience under humid, thermal, and light stress, outperforming their pristine counterparts. Specifically, BMIM-Pb(SCN)3 proves particularly effective, synergistically enhancing both charge-carrier mobility and long-term film stability. This dual-functional additive strategy not only passivates defects but also regulates the structural evolution of the perovskite layer, leading to improved optoelectronic performance. These findings present a viable route for stabilizing hybrid perovskites and advancing their practical deployment in photovoltaic and optoelectronic applications.

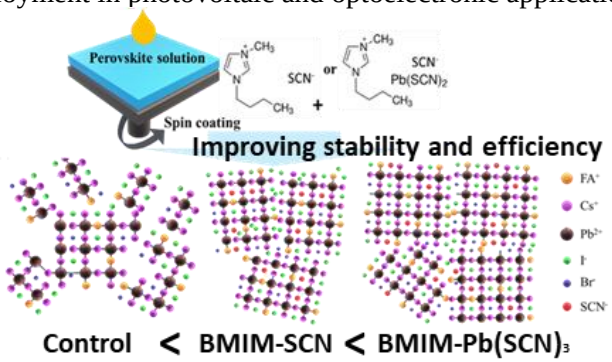


Fig. 1 Schematic illustration of the fabrication of perovskite thin film with additives and enhancement crystallinity

[References]

(1) M. S. Bae, Y. H. Chang, W. Lee, C. S. Moon, S. W. Kim, H. S. Kim, J. Lim and T. Y. Yang, *Energy and Fuels*, **2023**, *37*, 4608–4615.

(2) Y.-H. Lin, N. Sakai, P. Da, J. Wu, H. C. Sansom, A. J. Ramadan, S. Mahesh, J. Liu, R. D. J. Oliver, J. Lim, L. Aspitarte, K. Sharma, P. K. Madhu, A. B. Morales-Vilches, P. K. Nayak, S. Bai, F. Gao, C. R. M. Grovenor, M. B. Johnston, J. G. Labram, J. R. Durrant, J. M. Ball, B. Wenger, B. Stannowski and H. J. Snaith, *Science* (80-.)., **2020**, *369*, 96–102.

[Poster 01-13]

Investigating Mechanism of Enhanced Photostability in Passivated Perovskite Solar Cells via Anti-solvent Additives

Wonjong Lee[a#], Muhammad Adnan[a], Zobia Irshad[a], Siwon Yun[a], Hyeji Han[a], and Jongchul Lim[a,*]
[a]Graduate School of Energy Science and Technology, Chungnam National University, Daejeon, 34134, Republic of Korea.
Email: jclim@cnu.ac.kr

Keywords: perovskite solar cells, anti-solvent additive, passivation, photostability, spectroscopy**.**

Metal-halide perovskite solar cells (PSCs) achieve high power-conversion efficiencies but remain susceptible to photo-induced degradation caused by mobile ions and phase segregation.1-3 Here, we introduce positional isomers additives, as ultra-dilute anti-solvent additives and use a suite of structural, optical and electrical probes to track their impact on film quality and device stability. All two additives enlarge grain size and lower trap density, yet the additives that features the carboxyl group opposite the pyridine nitrogen delivers the strongest passivation, reducing trap density by ≈ 27%, suppressing light-induced red-shift behaviour in photoluminescence, and enabling unencapsulated devices to retain >90% of their initial efficiency after 1,000 hours of continuous 1-sun illumination. Spectroscopic and transient measurements reveal that the additive simultaneously passivates Pb-related defects and halide vacancies, thereby inhibiting ion migration and halide phase segregation under operation. These results establish functional-group orientation as a powerful, easily implemented design rule for molecular passivators that substantially extend the operational lifetime of perovskite photovoltaics.

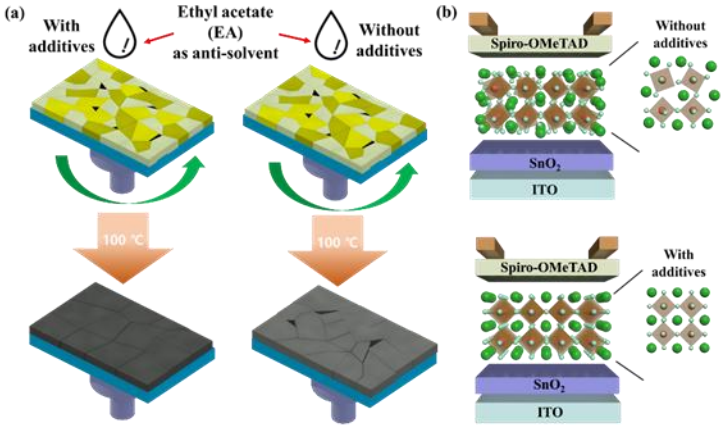


Fig. 1 a) Schematic diagram of the anti-solvent additive method for fabricating perovskite films, and b) device architecture with and without additives.

[References]

(1) Kojima, A.; Teshima, K.; Shirai, Y.; Miyasaka, T. *J. Am. Chem. Soc.* **2009**, *131*, 6050– 6051

(2) Arora, N.; Dar, M. I.; Abdi-Jalebi, M.; Giordano, F.; Pellet, N.; Jacopin, G.; Friend, R. H.; Zakeeruddin, S. M.; Grätzel, M. *Nano Lett.* **2016**, *16*, 7155– 7162

(3) H. Fang, J. Yang, S. Tao and S. Adjokatse, *Adv. Funct. Mater.* **2018**, *28*, 1800305

[Poster 01-14]

Elucidating the Lead Halide Perovskite Crystallization via Optoelectronic Measurement

Hyeji Han[a#], Muhammad Adnan[a], Zobia Irshad[a], Wonjong Lee[a], Siwon Yun[a], Hyeji Han[a], Minkyu Kim[a], and Jongchul Lim[a,*],
[a]1Graduate School of Energy Science and Technology, Chungnam National University, Daejeon, 34134, Republic of Korea.
Email: jclim@cnu.ac.kr

Keywords: Perovskite, Precursor, Crystallization, Scattering, Solar cells

Metal halide perovskite materials have attracted significant attention in the field of photovoltaics due to their excellent optoelectronic properties, such as solution processability, tunable band gap, long charge-carrier lifetimes, and high carrier mobilities. In this study, we investigate the crystallization process of lead halide perovskites with 4 critical parameters. In Crystallization process, the solution concentration, purity, temperature, solubility is quite important[1]. During crystallization, the layered structure of PbI2 interacts with the A-site cation, resulting in a phase transformation into a three-dimensional ABX3 perovskite lattice composed of corner-sharing PbI6 octahedra[2]. This transformation is highly sensitive to processing conditions, including the solvent environment, temperature, and annealing process. By employing a combination of structural, morphological, and optical characterization techniques, we demonstrate that these parameters critically influence crystal quality, grain orientation, and defect density, thereby affecting the overall optoelectronic performances[3].

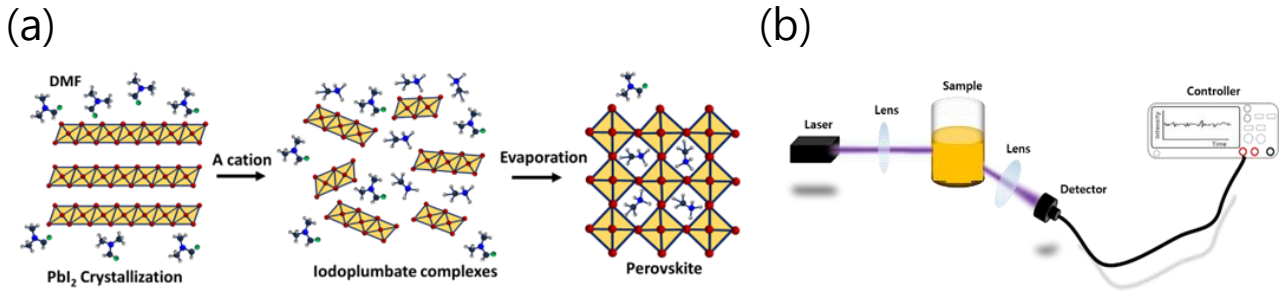


Fig. 1. (a) Perovskite crystallization mechanism; formation of PbI2 crystal; MAI attack to PbI2 layer structure and formation of Iodoplumbate complexes; Crystallization of ABX3 Perovskite structure (b) Schematic representation of the Potential measurement

[References]

(1) Nayak, P. K.; Moore, D. T.; Wenger, B.; Nayak, S.; Haghighirad, A. A.; Fineberg, A.; Noel, N. K.; Reid, O. G.; Rumbles, G.; Kukura, P.Mechanism for Rapid Growth of Organic-Inorganic Halide Perovskite Crystals. *Nat. Commun*. **2016**, *7* (1), 13303

(2) Shen, D.; Yu, X.; Cai, X.; Peng, M.; Ma, Y.; Su, X.; Xiao, L.; Zou, D. *J. Mater. Chem. A* **2014**, *2* (48), 20454– 20461

(3) Sanchez, S.; Pfeifer, L.; Vlachopoulos, N.; Hagfeldt, A. *Chem. Soc. Rev.* **2021**, *50* (12), 7108– 7131

[Poster 01-15]

Wafer-Scale Electronics Enabled by Direct Photopatterning of Green Solvent-Processed 2D Nanomaterials

Wan Ho Cho[a,#], In Cheol Kwak[b], Se-Jin Kim[c], Joohoon Kang[b,*], Jeong Ho Cho[b,*], BongSoo Kim[a,*]
[a]Department of Chemistry, Ulsan National Institute of Science and Technology (UNIST), Ulsan 44919, Republic of Korea
[b]Department of Chemical and Biomolecular Engineering, Yonsei University, Seoul 03722, Republic of Korea
[c]School of Advanced Materials Science and Engineering, Sungkyunkwan University (SKKU), Suwon 16419, Republic of Korea
Email: bongsoo@unist.ac.kr

Keywords: 2D nanomaterials, Crosslinker, Photopatterning, Green solvents, Transistors

Solution-processed two-dimensional (2D) nanomaterials are emerging as key elements for scalable fabrication of functional electronic devices.1 Solution processing enables network formation through van der Waals (vdW) interactions among nanosheets, reducing energy barriers and contact resistance for efficient charge transport.2 Yet, interfacial residues from synthesis or fabrication often limit performance. A major difficulty also lies in high-boiling, toxic solvents used for dispersions, which are difficult to remove, while conventional patterning methods require multiple solvents that can disrupt vdW interfaces and degrade devices.3 To address these issues, a crosslinker-based photopatterning process using an eco-friendly solvent is developed. Compatibility between nanomaterials and ultraviolet (UV)-sensitive cross-linkers is analyzed with Hansen solubility parameters to ensure dispersion stability under photopatterning. This method produces stable mixtures of 2D nanomaterials including graphene, MoS_2, WSe_2, and HfS_2 that assemble into vdW-bonded networks, enabling precise, large-area device integration. This sustainable framework unites stability, scalability, and environmental responsibility.

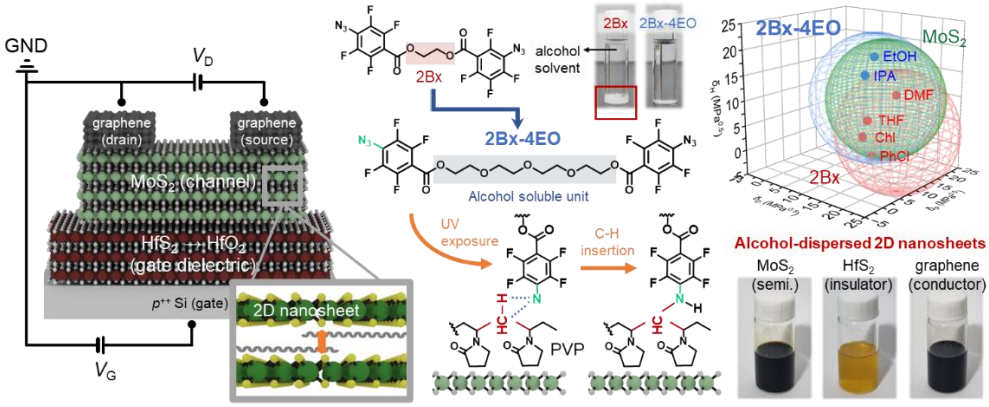


Fig. 1. The figure illustrates the structure and processing of photopatterned 2D nanomaterials for FETs

[References]

(1) M. Bat-Erdene, A. S. R. Bati, J. Qin, H. Zhao, Y. L. Zhong, J. G. Shapter, M. Batmunkh, *Adv. Funct. Mater*. **2022,** *32*, 2107280

(2) G. Tang, P. You, Q. Tai, A. Yang, J. Cao, F. Zheng, Z. Zhou, J. Zhao, P. K. L. Chan, F. Yan, *Adv. Mater*. **2019,** *31*, 1807689

(3) C.-H. Lin, B. Cheng, T.-Y. Li, J. R. D. Retamal, T.-C. Wei, H.-C. Fu, X. Fang, J.-H. He, *ACS Nano* **2019**, *13*, 1168

[Poster 01-16]

Optimization of Recognition-Site Localization in Side-Gated Organic Electrochemical Transistor Immunosensors

Heeyoung Park[a,#], Jiyoul Lee [a,b,*]
[a]Department of Smart Green Technology Engineering, Pukyong National University, 45 Yongso-ro, Nam-gu, Busan 48513, Republic of Korea.
[b] Department of Semiconductor Engineering, Pukyong National University, 45 Yongso-ro, Nam-gu, Busan 48513, Republic of Korea
Email: jiyoul_lee@pknu.ac.kr

Keywords: Organic Electrochemical Transistor, Immunosensors, Infectious diseases, Antibody detection

We quantify how recognition-layer placement governs signal transduction in OECT immunosensors operating at low voltage in aqueous media. Side-gated, coplanar PBTTT-C14 devices with gold source/drain/side-gate electrodes were benchmarked for human IgG detection in PBS (pH 7.4). Otherwise identical chips were functionalized at (i) the channel, (ii) the gate, or (iii) both; nonspecific adsorption was suppressed with BSA. Electrical readouts (ID–VG, IG–VG) exhibited canonical immuno-recognition signatures with increasing IgG: attenuation of ON-state drain current, positive threshold-voltage shifts, and suppression of gate current. Critically, response magnitude and repeatability depended on localization: channel-localized devices delivered the strongest, most reproducible modulation; dual-site showed intermediate behavior; gate-localized responded the weakest. Among metrics, gate current provided the highest dynamic contrast and concentration resolution, sensitively reporting interfacial modification. These trends follow OECT physics. Protein binding at the channel raises interfacial impedance and limits volumetric ionic charging, directly weakening doping/de-doping efficiency; gate-site perturbations are partly screened and dissipated by electrolyte resistance and spatial separation[1,2]. Thus, a channel-localized strategy mitigates Debye screening in high-ionic-strength PBS, maximizes sensitivity and stability, and reduces inter-device dispersion in ΔVT and normalized current change (ΔID/ID0), easing calibration and improving robustness to process variation. The resulting design rule—localize recognition at the channel—generalizes across electrode materials, electrolytes, and operating conditions, and supports scalable multiplexed arrays and portable, low-voltage readers. Ultimately, recognition-layer positioning is a decisive lever for engineering high-performance OECT immunosensors.

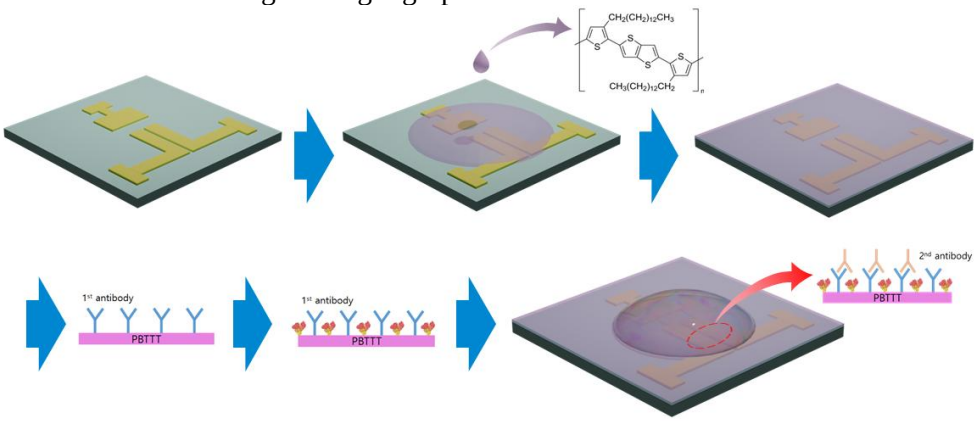


Fig. 1. Fabrication process of side-gated organic electrochemical transistor immunosensors

[References]

(1) Rashid, R. B.; Ji, X.; Rivnay, Biosens. *Bioelectron*. **2021**, *190*, 113461.

(2) Inal, S.; Malliaras, G. G.; Rivnay, J., *Nat. Commun*. **2017,** *8*, 1767.

[Poster 01-17]

Synergistic Conformal of Multifunctional Phenothiazine-Based Self-Assembled Monolayers for Better Interface Contact in High-Efficient and Stable Perovskite Solar Cells

Qurrotun Ayuni Khoirun Nisa[a,b#], Rahmatia Fitri Binti Nasrun[a,b], Dong Hwan Son[a,b], Joo Hyun Kim[a,b*]
[a]Department of Polymer Engineering, Pukyong National University, Busan 48513, Korea
[b]CECS Research Institute, Core Research Institute, Busan 48513, Korea
Email: jkim@pknu.ac.kr

Keywords: interface engineering, phenothiazine, self-assembled monolayer, perovskite solar cells, inverted

Self-assembled monolayers (SAMs) are widely used for interfacial engineering in perovskite solar cells (PSCs). However, conventional organic SAMs face challenges in large-area processing. Their ultrathin structure limits the formation of uniform layers by spin-coating, while their hydrophobic nature hinders perovskite precursor deposition which results in poor film coverage. To overcome these issues, we report a phenothiazine-based SAM (PTZ-PA) formed through synergistic co-adsorption with a hydrophilic phosphonic acid, serving as the hole transport layer in inverted PSCs. PTZ-PA increases surface energy, promoting uniform film growth with improved morphology and crystallinity. The phosphonic acid group coordinates strongly with lead (Pb) in the perovskite lattice, enhancing interfacial adhesion, electronic coupling, and charge transfer, which ensures efficient hole extraction and stable p-type selective contacts. Devices employing PTZ-PA achieve a remarkable power conversion efficiency of 23.2% and exhibit long-term operational stability, retaining performance for over 500 hours under continuous illumination. These findings highlight PTZ-PA as a scalable interfacial modification strategy for high-performance and durable PSCs.

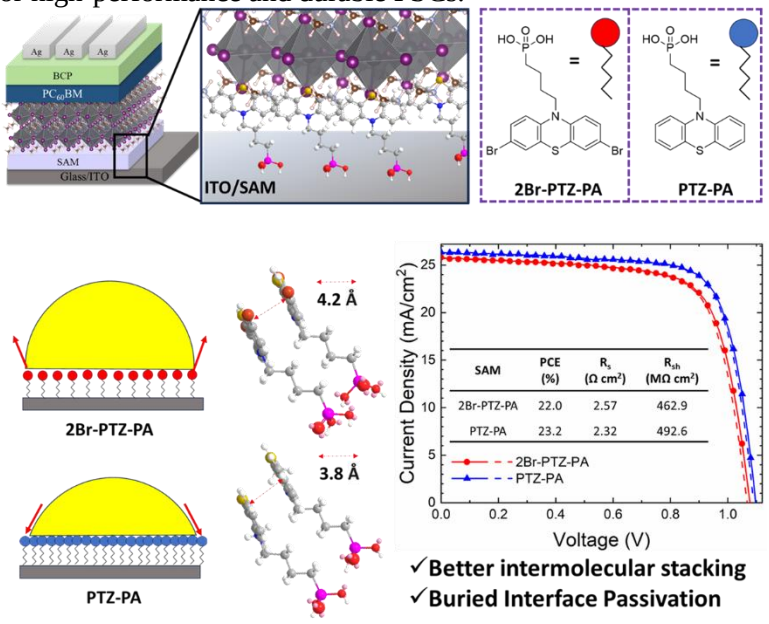


Fig. 1. Schematic illustration of inverted perovskite solar cells employing phenothiazine-based self-assembled monolayers.

[References]

(1) Nisa, Q. A. K.; Nasrun, R. F. B.; Kim, J. H. Small. *Methods* **2025**, 2402104

[Poster 01-18]

Multi-site Interaction of Ligands for High Performance Perovskite Solar Cells

Jinhyuk Choi[a,#], Yong-Young Noh[a,*], Taiho Park[a,*]
[a]Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, 37673, Republic of Korea
Email: yynoh@postech.ac.kr

Keywords: perovskite, Lewis base ligand, crystallization, defect passivation

Lead halide perovskites have emerged as highly promising photovoltaic materials owing to their remarkable optoelectronic properties1. Nevertheless, perovskite films inherently suffer from a high density of defects, originating from intrinsic material instability and uncontrolled crystallization during solution processing. These defects accelerate nonradiative recombination and ion migration of perovskites, thereby limiting device efficiency and operational stability2. To overcome these challenges, we employed multifunctional phosphine-based ligands capable of simultaneously coordinating with undercoordinated Pb^{2+} ions and forming hydrogen bonds with A-site cations. Such dual interactions effectively regulate the crystallization pathway, resulting in uniform and compositionally homogeneous films with enlarged grains and improved crystallinity, while concurrently passivating surface and grain boundary defects. As a result, the ligand-modified perovskite solar cells achieved a power conversion efficiency of 25.46% along with outstanding long-term stability, retaining over 85% of the initial efficiency after 800 hours under high temperature of 75 ℃ at an inert condition. This work highlights a rational ligand design strategy that provides new insights into the development of high-performance and durable perovskite solar cells.

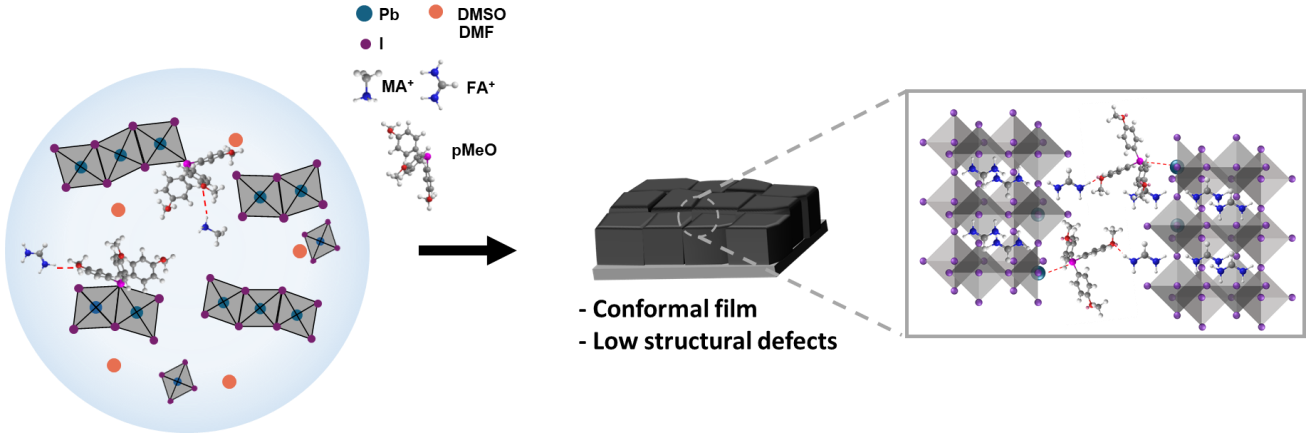


Fig. 1. Controlled crystallization via pMeO.

[References]

(1) S. Liu, J. Li, W. Xiao, R. Chen, Z. Sun, Y. Zhang, X. Lei, S. Hu, M. Kober-Czerny, J. Wang, F. Ren, Q. Zhou, H. Raza, Y. Gao, Y. Ji, S. Li, H. Li, L. Qiu, W. Huang, Y. Zhao, B. Xu, Z. Liu, H. J. Snaith, N.-G. Park and W. Chen, *Nature*, **2024**, *632*, 536–542

(2) Z. Fang, L. Wang, X. Mu, B. Chen, Q. Xiong, W. D. Wang, J. Ding, P. Gao, Y. Wu and J. Cao, *J. Am. Chem. Soc*., **2021**, *143*, 18989–18996

[Poster 01-19]

Room-Temperature Magnetic-Field-Free Circularly Polarized Luminescence from Individual Perovskite Quantum Emitters

Hung-Ming Chen[a,#], Chi-Chi Wu[b], Dun-Jie Jhan[a], Ming-Yen Lu[a], Pi-Tai Chou[b], and Hao-Wu Lin[a,*]
[a]Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu 30013, Taiwan
[b]Department of Chemistry, National Taiwan University; Taipei, 10617, Taiwan
Email: hwlin@mx.nthu.edu.tw

Keywords: circularly polarized luminescence, chiral, quantum emission, perovskite, quantum dots

Chiral quantum emitters have attracted increasing attention due to their non-reciprocal photon-mediated characteristics and potential roles in quantum technologies. Conventionally, achieving chiral quantum emission relies on demanding approaches such as applying magnetic fields or operating at cryogenic temperatures, and reports of room-temperature circularly polarized luminescence (CPL) from single emitters remain rare. In this work, we demonstrate that certain CsPbI3 perovskite quantum dots (PQDs) can simultaneously exhibit room-temperature single-photon emission and intrinsic CPL without external magnetic fields, even though no chiroptical activity was detected from ensemble PQDs. The PQDs were prepared by spray-synthesis without the addition of chiral surface ligands, helical supramolecules, or chiral metamaterials1. Remarkably, an unprecedented luminescence dissymmetry factor (glum) of up to 0.41 was achieved2. Density functional theory (DFT) calculations and transmission electron microscopy (TEM) characterization indicate that crystal imperfections induce band splitting, establishing a correlation between broken lattice symmetry and CPL properties. Circularly polarized excitation and CPL lifetime measurements reveal that the unequal spin population in the excited state determines the chiroptical activity of PQDs. This finding provides new insight into chiral emission from perovskites and suggests a possible origin of CPL, paving the way for future investigations.

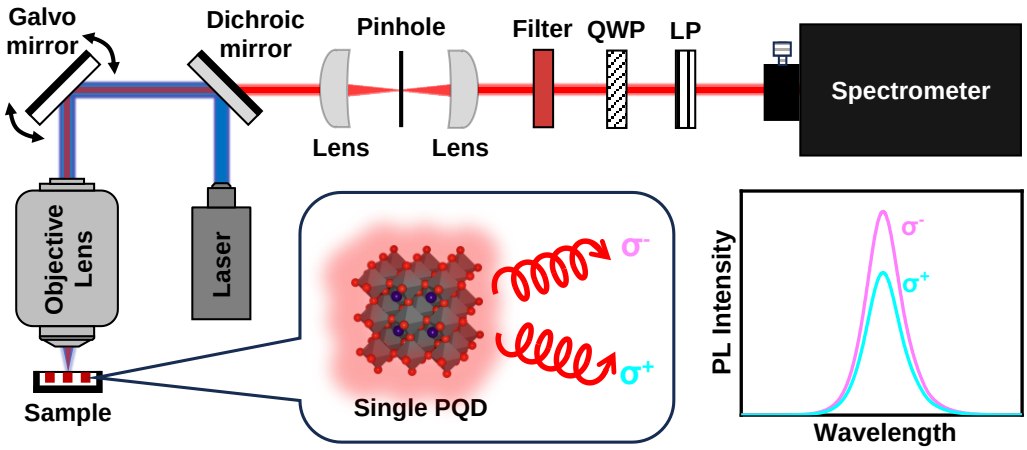


Fig. 1. Schematic diagram of circularly polarized luminescence (CPL) from individual $CsPbI_3$ perovskite quantum emitters using a home-built confocal CPL measurement system.

[References]

(1) Hsu, B.-W.; Chuang, Y.-T.; Cheng, C.-Y.; Chen, C.-Y.; Chen, Y.-J.; Brumberg, A.; Yang, L.; Huang, Y.-S.; Schaller, R. D.; Chen, L.-J.; Chuu, C.-S.; Lin, H.-W. *ACS Nano* **2021**, *15* (7), 11358– 11368

(2) Chen, H.-M.; Wu, C.-C.; Chuang, Y.-T.; Jhan, D.-J.; Chi, C.-C.; Lin, H.-C.; Lu, M.-Y.; Chou, P.-T.; Lin, H.-W., *Small*, **2025**, e07947.

[Poster 01-20]

Stabilizing CsPbI3 Quantum Dots in Polar Solvents via Zwitterion Passivation

Tzu-Hao Liao[a,#], Yung-Tang Chuang[a], Hao-Wu Lin [a,*]
[a]Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu 30013, Taiwan.
Email: hwlin@mx.nthu.edu.tw

Keywords: Perovskite Quantum Dots; $CsPbI_3$; Zwitterion; Polar Solvent Stability; Single-Photon Emission.

Metal halide perovskite quantum dots (PQDs) have emerged as highly attractive materials owing to their exceptional optoelectronic properties. With a general formula of ABX3, where A is a monovalent cation, B is a divalent metal cation, and X is a halide anion, these nanocrystals exhibit tunable bandgaps, intense photoluminescence, and intrinsic defect tolerance. Such features make PQDs promising candidates for applications in solar cells, light-emitting diodes, and quantum light sources. Despite these advantages, PQDs synthesized via conventional ligand strategies—typically employing oleic acid (OA) and oleylamine (OAm)—face critical limitations. In particular, their structural and optical stability deteriorates rapidly in polar environments due to ligand detachment and phase instability, which severely hinders their practical integration into advanced optoelectronic architectures1.

In this study, we successfully synthesized CsPbI3 PQDs with enhanced resistance to polar solvents by partially replacing the conventional ligands (OA and OAm) with the zwitterionic ligand 3-(decyldimethylammonio)-propane-sulfonate inner salt (DPIS) (Fig. 1a) via a modified spray-synthesis method2. The resulting zwitterion-capped PQDs exhibited near-unity photoluminescence quantum yield, excellent surface passivation, and remarkable stability in polar environments (Fig. 1b). Furthermore, single-photon measurements performed using a home-built confocal microscope equipped with a Hanbury Brown–Twiss interferometer revealed that individual DPIS-capped CsPbI3 PQDs maintained robust single-photon emission at room temperature, with a second-order correlation value at zero time delay of g(2)(0) = 0.089, demonstrating their high single-photon purity. Given their excellent single-photon characteristics and resilience in polar solvents, these PQDs hold great promise for future applications in advanced quantum light sources and related photonic technologies.

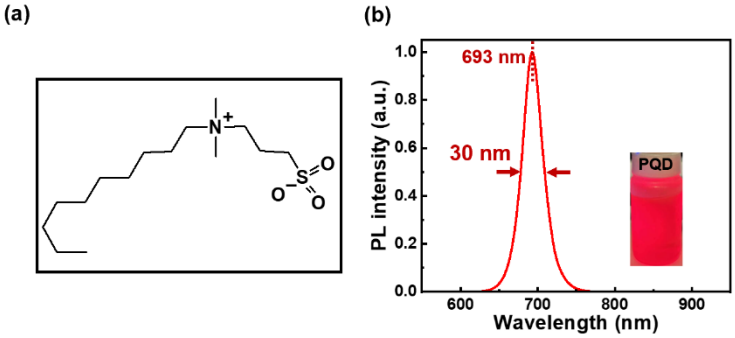


Fig. 1. (a) Chemical structure of DPIS. (b) PL spectrum of DPIS-capped CsPbI3 PQDs. The inset shows an image of the PQD solution under ultraviolet excitation.

[References]

(1) Fiuza-Maneiro, N.; Sun, K.; López-Fernández, I.; Gómez-Graña, S.; Müller-Buschbaum, P.; Polavarapu, L. *ACS Energy Lett.* **2023**, *8* (2), 1152– 1191

(2) Dai, S.-W.; Hsu, B.-W.; Chen, C.-Y.; Lee, C.-A.; Liu, H.-Y.; Wang, H.-F.; Huang, Y.-C.; Wu, T.-L.; Manikandan, A.; Ho, R.-M.; Tsao, C.-S.; Cheng, C.-H.; Chueh, Y.-L.; Lin, H.-W. *Adv. Mater.* **2018**, *30*, 1705532

[Poster 01-21]

High Mechanical Durability in Intrinsically Stretchable Neuromorphic Devices via Phase-Programmed Semiconducting Polymers

Kwan-Nyeong Kim[a,#], Hea-Lim Park[b], Yun-Hi Kim[c], Tae-Woo Lee[a,d,e*]
[a]Department of Materials Science and Engineering, Seoul National University, Seoul 08826, Republic of Korea.
[b]Department of Materials Science and Engineering, Seoul National University of Science and Technology, Seoul 01811, Republic of Korea.
[c]Department of Chemistry and RIMA, Gyeongsang National University, Jinju 52828, Republic of Korea.
[d]Research Institute of Advanced Materials, Interdisciplinary Program in Bioengineering, Institute of Engineering Research, Soft Foundry, Seoul National University, Seoul National University, Seoul, 08826, Republic of Korea.
[e]SN Display Co., Ltd. Seoul, 08826, Republic of Korea.
Email: twlees@snu.ac.kr

Keywords: Stretchable electronics, Intrinsically stretchable electronics, Neuromorphic electronics, Organic electronics, Semiconducting polymers

Intrinsically stretchable neuromorphic devices (ISNDs) are promising for wearable artificial intelligence, yet their commercialization has been hindered by poor mechanical durability. Conventional approaches that soften the conjugated backbone to impart stretchability typically achieve only ~103 cycles at 50% strain, with severe electrical degradation ~50%. Here, we report a molecular design strategy that achieves industrially relevant endurance of 105 cycles at 50% strain with less than 15% variation in current. Our approach incorporates a phase-programming moiety (PPM) into semiconducting polymer backbones, enabling controlled evolution of microstructure from bundle-like aggregates to mesh-like percolated networks. This mesh-like morphology forms robust long-range charge transport pathways that withstand large deformations while preserving the rigidity and electronic integrity of the conjugated moiety. As a result, ISNDs fabricated from this polymer exhibit stretchability up to 150% and stable neuromorphic behavior under cyclic strain. Within a reservoir computing framework, the devices maintain consistent classification accuracy (~89% for handwritten and ~90% for spoken digits) even after 105 mechanical cycles. This level of resilience corresponds to over a year of continuous daily use, meeting requirements for commercial deployment. Our results introduce a molecular design paradigm that provides commercialization-level of device-level mechanical durability for practical wearable and neuromorphic electronics.

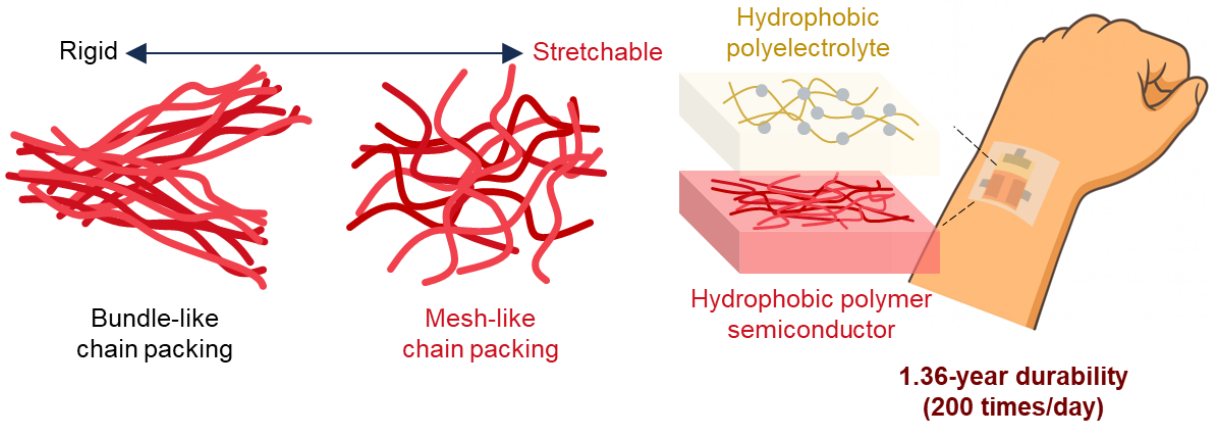


Fig. 1. Phase-programming of semiconducting polymer films for mechanically durable ISNDs.

[Poster 01-22]

Four-dimensional (x, y, z, t) photoluminescence dynamics for probing vertical charge transport in perovskite solar cells

Boseung Je [a, #], Changsoon Cho [a, *]
[a] Department of Materials Science and Engineering, POSTECH, KS010, Republic of Korea
Email: cho23@postech.ac.kr

Keywords: Perovskite, Solar cells, Charge dynamics, Photoluminescence, Microscopy

Perovskite materials have emerged as promising candidates for solar cells owing to their high-power conversion efficiencies and cost-effective fabrication. Efficient charge collection in these devices relies on rapid charge carrier diffusion. However, a long-standing discrepancy exists between the relatively low diffusion coefficients reported in earlier studies and the near-unity charge collection efficiencies demonstrated in practice. We attribute this inconsistency to the limited understanding of nanoscale charge dynamics within perovskites.

In this preparation, we summarize our recent work employing a four-dimensional (x, y, z, t) carrier tracking technique to quantitatively resolve and visualize vertical charge diffusion. Our results show that intragrain and intergrain regions exhibit markedly different diffusion coefficients, and that both direct intragrain transport and indirect detour pathways are critical to efficient charge collection. Conventional approaches yield diffusivities of about 0.02 cm²/s, whereas four-dimensional tracking reveals a much higher value of 0.25 cm²/s—an order of magnitude larger. This higher diffusivity reconciles the previously observed discrepancy and explains the excellent performance of perovskite solar cells. Moreover, improved control over polycrystalline growth could enable micrometer-thick perovskite layers to simultaneously realize long optical paths and efficient charge collection.

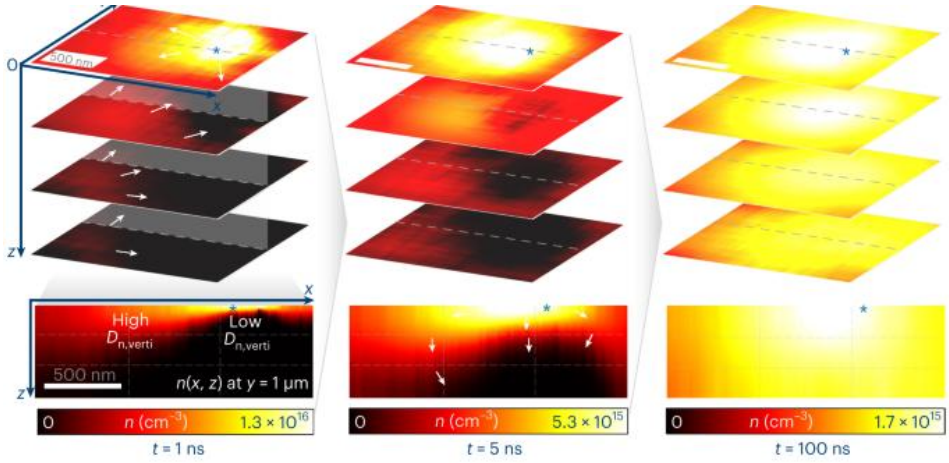


Fig. 1. Transient and spatial profiles of free charge carriers

[References]

(1) Cho, C., Feldmann, S., Yeom, K.M. et al. *Nat. Mater*. *21*, 1388–1395 (**2022**).

[Poster 01-23]

Perovskite quantum dots improve the efficiency of organic solar cells through synergistic enhancements in light absorption, exciton transport, and interfacial dipole alignment

Dong Hwan Son[a,b,#], Qurrotun Ayuni Khoirun Nisa[a,b], and Joo Hyun Kim[a,b,*]
[a]Department of Polymer Engineering, Pukyong National University, Busan 48513, Korea
[b]CECS Research Institute, Core Research Institute, Busan 48513, Korea
Email: jkim@pknu.ac.kr

Keywords: Perovskite quantum dot, electron transport layer, FRET, organic solar cells

Organic solar cells (OSCs) integrating a $FAPbI_3$ perovskite quantum dot (PQD)–based electron transport layer (ETL) exhibit notable improvements in power conversion efficiency (PCE) and device stability. The PQD ETL extends light absorption from the ultraviolet to the near-infrared region, effectively complementing the PM6:Y6BO active layer. In addition, Förster resonance energy transfer (FRET) from PQDs enhances exciton generation and photocurrent, while their intrinsic dipole moment promotes favorable energy-level alignment and efficient charge transport. As a result, the PCE increases from 15.4% to 18.0%, with the short-circuit current density (Jsc) rising from 25.4 to 28.9 mA cm^{-2}. The devices also achieve an external quantum efficiency of 88% at 570 nm, along with a charge dissociation probability of 99.0% and reduced recombination losses. Importantly, the PQD-based OSC maintains 95% of its initial PCE after one week and 85% after 16 days, surpassing the stability of the reference device. These results highlight PQDs as multifunctional ETL materials that simultaneously broaden optical absorption, improve charge dynamics, and enhance operational durability, offering a promising strategy for advancing OSC performance[1].

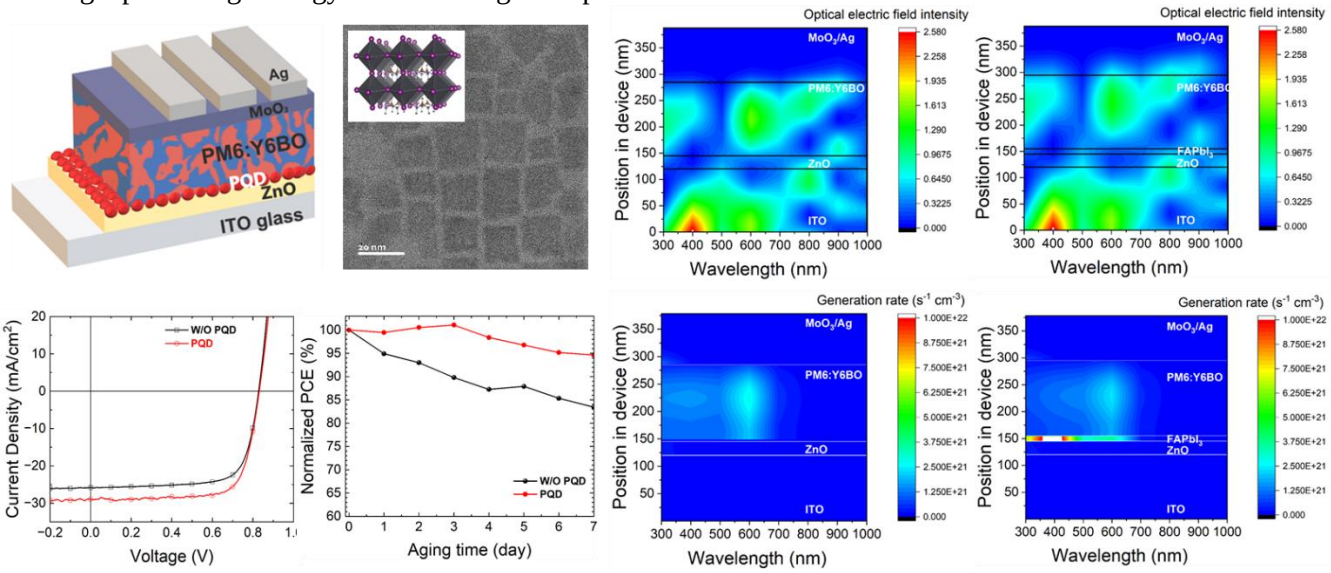


Fig. 1. Device architecture, optical simulations, and photovoltaic characteristics of OSCs incorporating PQDs as electron transport layers

[References]

(1) V. S. Katta, D. H. Son, J. H. Kim, *Adv. Opt. Mater.*, **2025**, e01085

[Poster 01-24]

Vertical phase separation induced highly efficient pseudo-bilayer photoanodes for organic photoelectrochemical cells

Jaehyeong Kim,[a] Soonyong Lee,[#b] Yeonjeong Lee,[a] Tack Ho Lee,[c] Jin Young Kim[*a] and Han Young Woo[*b]
[a]School of Energy and Chemical Engineering, Ulsan National Institute of Science and Technology (UNIST), Ulsan 44919, Republic of Korea.
[b] Department of Chemistry, Korea University, Republic of Korea.
[c] Graduate Department of Chemical Materials, Institute for Plastic Information and Energy Materials, Sustainable Utilization of Photovoltaic Energy Research Center, Pusan National University, Busan 46241, Republic of Korea.
Email: hywoo@korea.ac.kr

Keywords: Photoelectrochemical cell, Conjugated small molecule, Photoanode, Vertical phase separation

Replacing the alkyl side chains in 2,2′-((2Z,2′Z)-((4,4,9,9-tetrahexyl-4,9-dihydro-s-indaceno[1,2-b:5,6-b′]dithiophene-2,7-diyl)bis(methanylylidene))bis(3-oxo-2,3-dihydro-1H-indene-2,1-diylidene))dimalononitrile (IDIC) with polar diethylene glycol to form the hydrophilic acceptor 2,2′-((2Z,2′Z)-((4,4,9,9-tetrakis(2-(2-(2-methoxyethoxy)ethoxy)ethyl)-4,9-dihydro-s-indaceno[1,2-b:5,6-b′]dithiophene-2,7-diyl)bis(methaneylylidene))bis(3-oxo-2,3-dihydro-1H-indene-2,1-diylidene))dimalononitrile (IDIC-DEG) induced vertical phase separation (VPS) with the hydrophobic donor poly[(2,5-bis(2-hexyldecyloxy)phenylene)-alt-(5,6-difluoro-4,7-di(thiophen-2-yl)benzo[c]-thiadiazole)] (PPDT2FBT) due to surface energy differences, leading to IDIC-DEG accumulation near the ZnO bottom layer. The photoelectrochemical properties of PPDT2FBT : IDIC and PPDT2FBT : IDIC-DEG blends were studied and compared. The VPS in PPDT2FBT : IDIC-DEG optimized charge extraction in photoelectrochemical cells and stable ZnO/IDIC-DEG interface prevented delamination in water. The DEG side chain also increased the dielectric constant and water uptake, reducing charge transfer resistance, resulting in significantly improved photocurrent and photoanode stability.

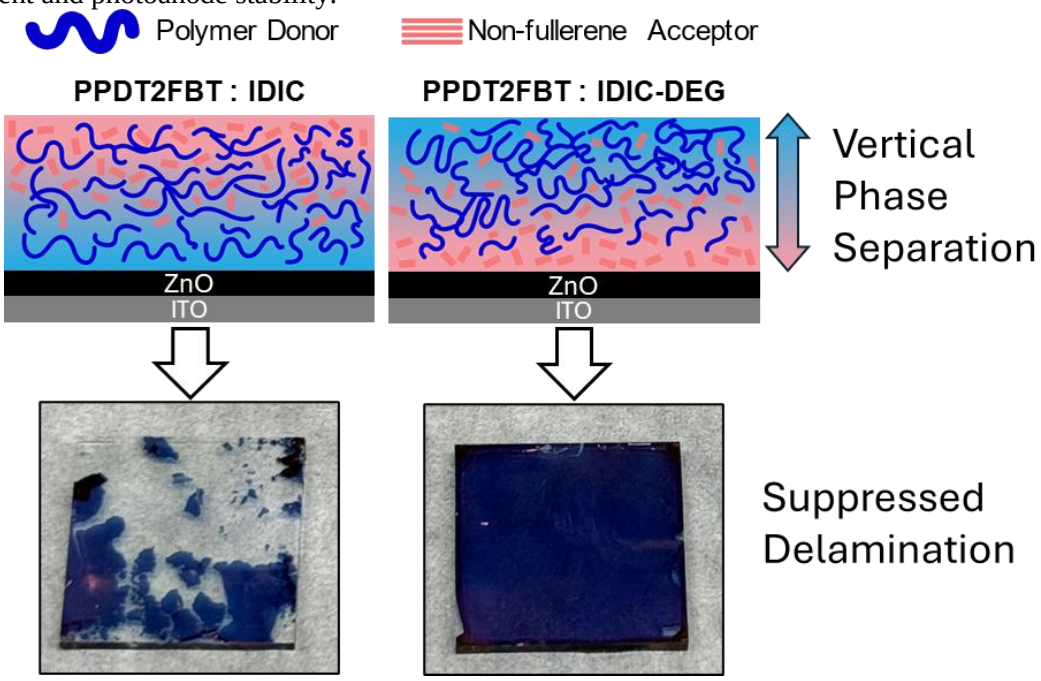


Fig. 1. Vertically phase separated photoelectrochemical active layer and their stability

[Poster 01-25]

Deconvoluting PL Spectra in Mixed-Halide Perovskites: Insights into Phase Segregation via Dual fITTING mODEL

Asawar Batool[a#], Muhammad Adnan[a], Zobia Irshad[a], Wonjong Lee[a], Siwon Yun[a], Hyeji Han[a], Minkyu Kim[a] and Jongchul Lim[a,*]
[a]Graduate School of Energy Science and Technology, Chungnam National University, Daejeon, 34134, Republic of Korea.
Email: jclim@cnu.ac.kr

Keywords: Mixed Halide Perovskite Solar Cell, Dual Fitting Model, Iodide & Bromide rich Domains, photoluminescence spectra deconvolution, Asymmetry.

Simulation of photoluminescence spectra is crucial for understanding the performance of mixed-halide perovskite solar cells, providing predictive insight into complex physical phenomena that influence device performance and efficiency. Mixed-halide perovskites offer tunable bandgaps and high photovoltaic potential, however suffer from halide phase segregation under illumination, resulting in broadened and asymmetric PL peaks due to Br-rich and I-rich domains[1] and further complicated by photon recycling effects. Here, we employed a dual-model fitting strategy using Voigt and Skewed Gaussian functions to deconvolute PL spectra. Voigt functions model the emission from Br-rich domains, while skewed Gaussian capture the asymmetric, red-shifted emission from I-rich domains. This approach allows for effective deconvolution of overlapping peaks and precise quantification of phase-specific contributions. As a result, this simulation-based framework enhances the understanding of phase segregation dynamics, leading to improved understanding of device stability and enhanced optimization strategies.

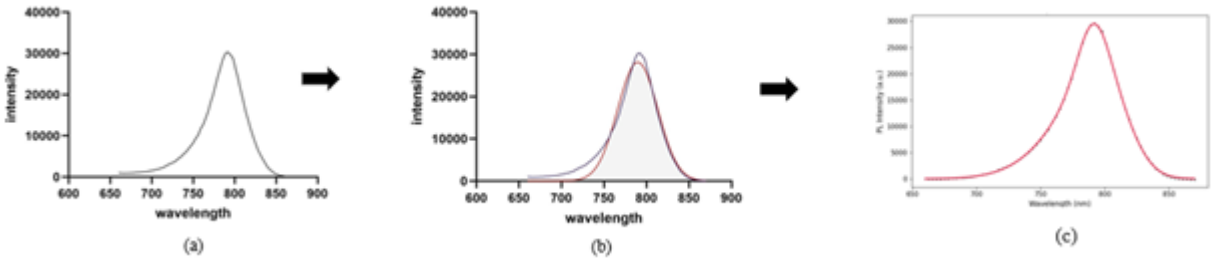


Figure 1 a) Experimental PL Spectra, b) Under Fitted PL Spectra with Halide Segregation, and c) Expected Fit of PL Spectra with segregated halides rich domains

[References]

(1) Motti, S. G.; Patel, J. B.; Oliver, R. D. J.; Snaith, H. J.; Johnston, M. B.; Herz, L. M. *Nat. Commun.* **2021**, *12* (1), 6955

[Poster 01-26]

Fabrication of Inorganic Perovskite Thin Film Using Vacuum Deposition System

Minkyu Kim[a,#], Muhammad Adnan[a], Zobia Irshad[a], Wonjong Lee[a], Siwon Yun [a], Hyeji Han[a], and Jongchul Lim[a,*]
[a]Graduate School of Energy Science of Technology, Chungnam National University, Daejeon 34134, Republic of Korea
Email: jclim@cnu.ac.kr

Keywords: perovskite solar cell, inorganic perovskite, vacuum deposition, thin-film process, thermal evaporation

Perovskite thin-film solar cells (PSCs) have garnered significant attention as promising candidates for next-generation photovoltaic devices due to their remarkable power conversion efficiency (PCE), and low cost. However, the commercialization of perovskites is hindered by their low thermal stability. In contrast, inorganic perovskite thin films offer greater thermal stability, driving increased research interest in this area. Among fabrication techniques, vacuum deposition has proven highly effective, producing solvent-free thin films with superior coverage, purity, and reproducibility compared to solution-based processes. Furthermore, vacuum deposition supports continuous deposition, a critical advantage for manufacturing multilayer thin-film solar cells. As a result, this technique has become a cornerstone in the production of high-purity, thermally stable inorganic perovskite thin films.

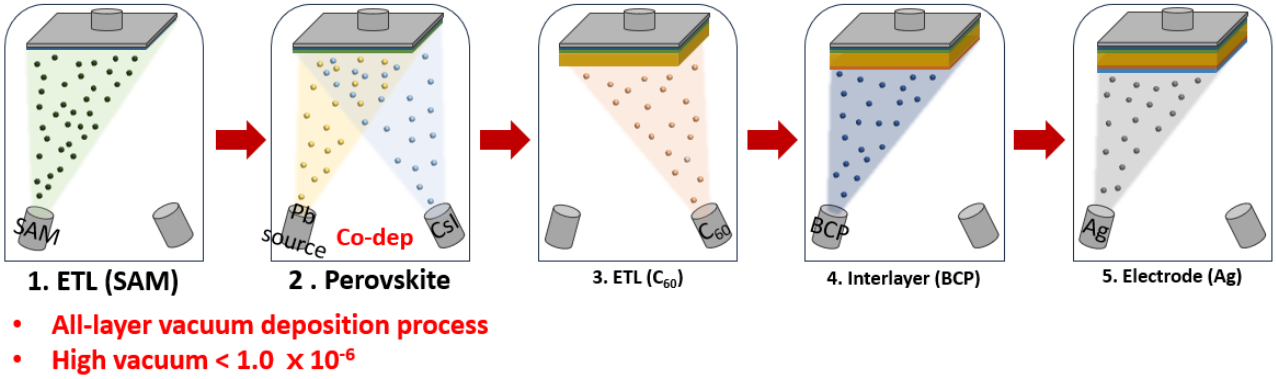


Fig. 1. Device fabrication process

[Poster 01-27]

Defect Management and Charge Dynamics Regulation by Cesium-Doped SnO2 for Highly Efficient and Stable Perovskite Solar Cells

Muhammad Adnan,[a#] Wonjong Lee,[a] Zobia Irshad,[a] Siwon Yun,[a] Hyeji Han,[a] Minkyu Kim,[a] Jongchul Lim, [a*]
[a]Graduate School of Energy Science and Technology, Chungnam National University, Daejeon 34134, Republic of Korea.
Email: jclim@cnu.ac.kr

Keywords: Cs-Doping, Interfacial defects. Charge-carrier dynamics, Surface passivation, Perovskite solar cells.

Tin oxide (SnO2) has emerged as a promising electron transport layer (ETL) for perovskite solar cells (PSCs), offering advantages over TiO2 due to its low-temperature processing and favorable optoelectronic properties. Nevertheless, intrinsic limitations such as band misalignment, charge extraction inefficiency, conductivity issues, and interfacial recombination still hinder device performance.1-2 In this work, we introduce cesium (Cs) doping into SnO2 to address these challenges and systematically investigate its effect on interfacial defect passivation, charge-carrier dynamics, and film quality. Cs incorporation enhances SnO2 transparency, crystallinity, and conductivity, while reducing trap densities and recombination losses. As a result, Cs-doped SnO2-based PSCs achieve a power conversion efficiency of 22.1%, compared to 20.2% for pristine SnO2 devices. Furthermore, Cs-modified devices exhibit superior environmental stability, maintaining performance under >65% relative humidity without encapsulation. These results highlight Cs-doped SnO2 as an effective ETL strategy for achieving highly efficient and air-stable planar PSCs.

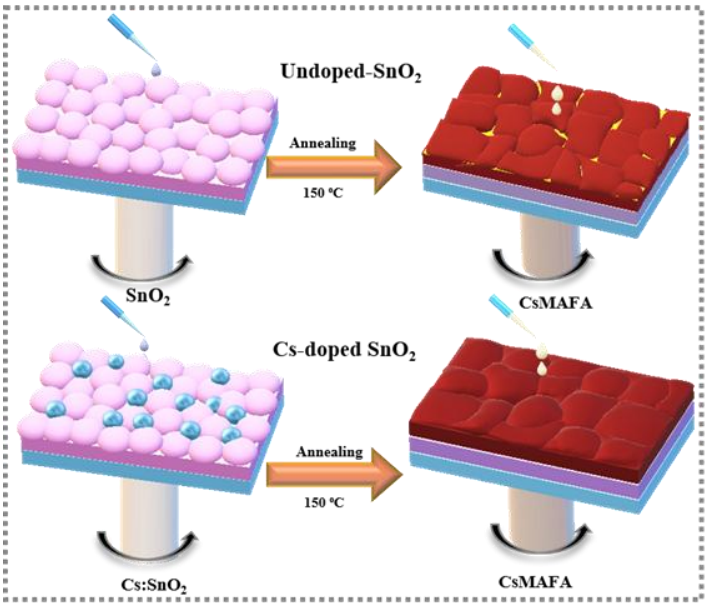


Fig. 1. Schematic representation of the perovskite film formation process on SnO2 and Cs:SnO2 ETL.

[References]

(1) Seo, G.; Yoo, J. J.; Nam, S.; Lee, D. S.; Gao, S.; Kim, B. K.; Sung, S. J.; Kang, B. J.; deQuilettes, D. W.; Park, J., et. al. *Nat. Energy* **2025**, *10*, 774– 784

(2) Paik, M. J.; Kim, Y. Y.; Kim, J.; Park, J.; Seok, S. I. *Joule* **2024**, *8* (7), 2073– 2086

[Poster 01-28]

Strain Regulation and Defect Passivation with 2D Organic Halide Salts for Air-Stable Perovskite Solar Cells

Zobia Irshad,[a,#] Muhammad Adnan,[a] Wonjong Lee,[a] Siwon Yun,[a] Hyeji Han,[a] Minkyu Kim,[a] Jongchul Lim, [a,*]
[a]Graduate School of Energy Science and Technology, Chungnam National University, Daejeon 34134, Republic of Korea.
Email: jclim@cnu.ac.kr

Keywords: Strain management, 2D/3D perovskite, Charge-carrier dynamics, Defects passivation, perovskite solar cells.

Minimizing lattice strain and interfacial non-radiative recombination is essential for achieving high efficiency and durability in perovskite solar cells (PSCs).1-2 Here, we employ ammonium halide salts (I^-, Br^-, Cl^-) to form 2D capping layers on 3D CsMAFA perovskites, enabling surface recrystallization, defect passivation, and strain relaxation. Combined theoretical and experimental analyses reveal halide-dependent diffusion behavior and interactions with undercoordinated Pb2+ ions. Notably, chloride salts penetrate deeper into the perovskite lattice, exhibit stronger hydrogen bonding with FA/MA, and effectively suppress point defects and PbI2 formation. This leads to enhanced crystallinity, grain orientation, and improved charge-carrier dynamics. Devices treated with chloride salts achieve a PCE of 23% and retain 91% efficiency under 15-25% relative humidity, compared to 71% degradation in control devices. These results highlight halide-mediated interface engineering as a powerful strategy to alleviate lattice strain, minimize recombination losses, and enable highly efficient, air-stable PSCs.

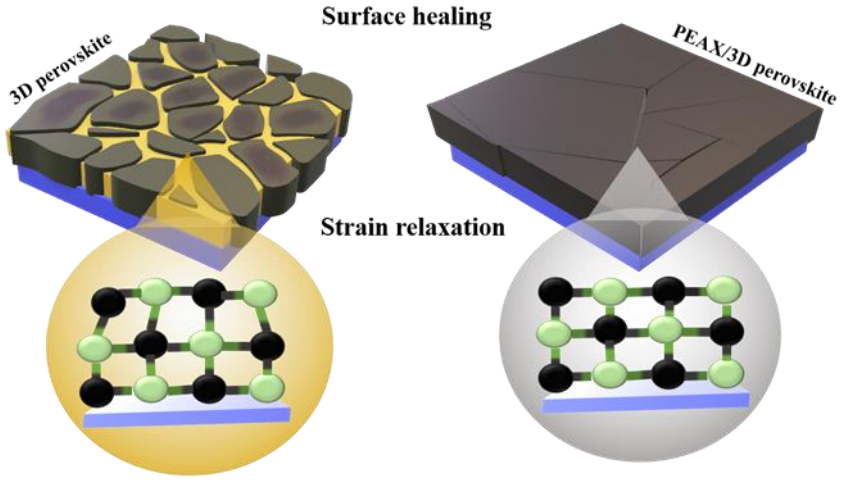


Fig. 1. Schematic representation of the strain management on 3D and PEAX/3D perovskite film.

[References]

(1) Chang, X.; Azmi, R.; Yang, T.; Wu, N.; Jeong, S. Y.; Xi, H.; Satrio Utomo, D.; Vishal, B.; Isikgor, F. H.; Faber, H.; Ling, Z.; He, M.; Marengo, M.; Dally, P.; Prasetio, A.; Yang, Y.-Y.; Xiao, C.; Woo, H. Y.; Zhao, K.; Heeney, M.; De Wolf, S.; Tsetseris, L.; Anthopoulos, T. D. *Nat. Commun.* **2025**, *16* (1), 1042

(2) He, D.; Chen, P.; Steele, J. A.; Wang, Z.; Xu, H.; Zhang, M.; Ding, S.; Zhang, C.; Lin, T.; Kremer, F.; Xu, H.; Hao, M.; Wang, L. *Nat. Nanotechnol.* **2025**, *20*, 779– 786

[Poster 01-30]

Development of Sulfur-Containing Narrowband Emitters with Exquisitely Tuned Luminescence Colors

Daiki Endo[a,#], Takuma Yasudaa,[b,*]
[a]Graduate School of Engineering, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan.
[b]Institute for Advanced Study, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan.
Email: yasuda@ifrc.kyushu-u.ac.jp

Keywords: Thermally activated delayed fluorescence, Organic light-emitting diode, Narrowband emission.

Thermally activated delayed fluorescence (TADF) materials are suitable for application in organic light-emitting diodes (OLEDs) due to their excellent exciton harvesting properties via reverse intersystem crossing (RISC). In TADF systems, RISC involving spin-flip processes is the rate-limiting step, and accelerating RISC is a important challenge for improving emitter performance. The focus on ultrahigh-definition displays utilizing OLEDs has increased the importance of emission spectrum accuracy. Multiple resonance (MR) TADF materials exhibit narrowband emissions and have attracted significant attention as emitters with high color purity and high luminescence efficiency. We developed skyblue luminescent MR-TADF materials introduced with various chalcogens and demonstrated successful acceleration of exciton spin conversion through electronic perturbations of chalcogens1. The emission wavelength of MR-TADF materials can be controlled by the number and type of electron-donating and electron-withdrawing groups. However, strategies for color tuning to red emission are limited and involve difficulties in synthesis and increased molecular weight.

In this study, we propose a simple and effective luminescence color tuning from blue to red regions in a generic single-boron MR-TADF system. A sulfur-containing MR system with a fast RISC process and excellent optical properties was selected as the MR skeleton (Fig. 1a). Compounds 1–3 were synthesized from corresponding haloarene in three steps consisting of nucleophilic aromatic substitution, Pd-catalyzed coupling, and tandem lithiation−borylation−annulation reactions. The fundamental optical properties of the synthesized compounds were evaluated in toluene solution and thin films. The emission wavelengths of 1–3 in toluene solution were 463, 495, and 612 nm, exhibiting blue, green, and red emission, respectively (Fig. 1b). In addition, the full width at half maximum (FWHM) of the emission spectra were 25, 39, and 46 nm (0.15, 0.20, and 0.17 eV), exhibiting narrowband emissions. We measured transient photoluminescence decay to evaluate TADF properties and calculate the photophysical rate constants. Compounds 1 and 2 exhibited fast RISC rates in the order of 105 s−1 due to the electronic perturbation effect of sulfur. The OLEDs using 1–3 exhibited electroluminescence in blue, green, and red regions (Fig. 1c), with high maximum external quantum efficiency of 12–21%.

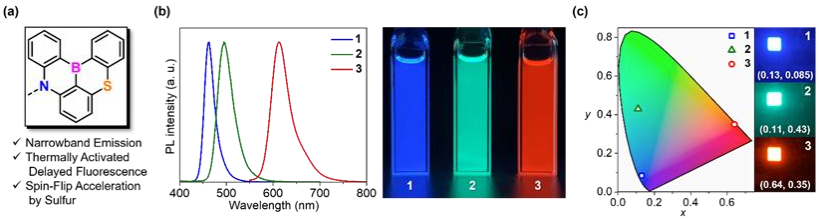


Fig. 1. a) Structure and characteristics of sulfur-containing MR system. b) PL spectra with corresponding emission images in toluene solution. c) EL emission images and their corresponding color coordinates in the CIE chromaticity diagram.

[References]

(1) I. S. Park, H. Min, T. Yasuda, *Angew. Chem. Int. Ed*. **2022**, *61*, e202205684.

[Poster 01-31]

Color-Tunable Narrowband Delayed Fluorescence in Peripherally Dendritic Modified Bis-Indolocarbazoles

Jun Hyeon Lee[a,#] and Takuma Yasuda[a,b,*]
[a]Department of Applied Chemistry, Graduate School of Engineering, Kyushu University
[b]Institute for Advanced Study, Kyushu University
Email: yasuda@ifrc.kyushu-u.ac.jp

Keywords: indolocarbazole, narrowband emission, dendritic modification, thermally activated delayed fluorescence, organic light emitting diodes

For next-generation ultrahigh-definition OLED displays, it is crucial to develop narrowband emitters that combine high efficiency with precise color purity to meet the BT.2020 standard. However, conventional organic luminophores suffer from broad emission spectra caused by structural relaxation and vibronic coupling. B,N-based multi-resonance (MR) systems address this limitation by providing sharp emissions, but their design space remains narrow because the MR effect requires the selective incorporation of B and N atoms at defined positions. In this context, structurally simple indolocarbazole derivatives have recently attracted attention as non-boron alternatives, yet most reported systems still display inadequate TADF activity and modest device performance.

Here, we present a dendritic modification strategy of the intrinsically narrowband indolo[3,2,1-jk]indolo[1′,2′,3′:1,7]indolo[3,2-b]carbazole (BICz) core to achieve color-tunable narrowband TADF emitters.1 By attaching arylamine-based dendritic peripheries, we developed BICz-1.5G, BICz-2G, and BICz-2GII, which maintain the sharp spectral features of BICz while enhancing TADF activity and enabling efficient emissions from deep blue to green. BICz-1.5G, BICz-2G, and BICz-2GII exhibited the photoluminescence peaks at 456, 479, and 508 nm, with full width at half maximum of 23, 25, and 29 nm, respectively. In addition to their favorable photophysical properties, the emitters exhibit excellent thermal stability (Td > 500 °C) despite their relatively high molecular weights (>1500 Da).

OLEDs fabricated by vacuum thermal evaporation exhibited narrowband electroluminescence with excellent color purity and high external quantum efficiencies of 24.0% for BICz-1.5G (CIE (0.13, 0.10)), 25.9% for BICz-2G (CIE (0.16, 0.38)), and 28.5% for BICz-2GII (CIE (0.21, 0.68)), far surpassing the 11% efficiency of unmodified BICz. These results indicate that the dendritic modification of the BICz core is promising as a simple and versatile molecular design strategy that significantly broadens the scope of non-boron narrowband luminophores and provides a practical route toward high-performance OLEDs tailored for BT.2020 displays.

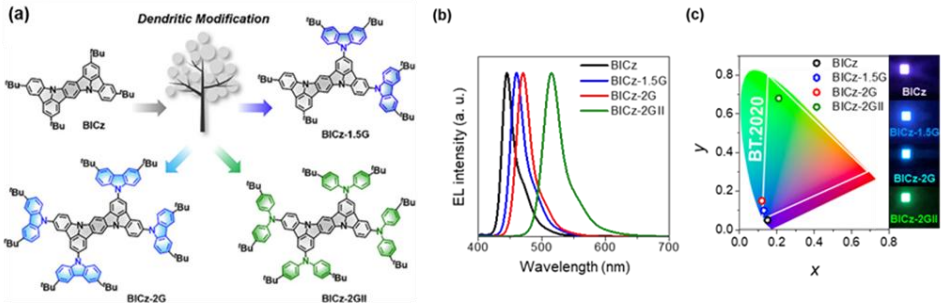


Fig. 1. a) Molecular structures of dendritic modified BICz derivatives. b) EL spectra measured at 1 mA cm−2. c) CIE color coordinates with EL emission images.

[References]

(1) J. H. Lee, T. Watanabe, L, Hartmann, and T. Yasuda. *Angew. Chem. Int. Ed*. **2025**, e202505191.

[Poster 01-32]

Development of Pyrimidopyrimidine-Containing Conjugated Polymer for Outdoor and Indoor Photovoltaics

Jiahui Duan[a,#], Asumi Sueyasu[b], Takuma Yasuda[a,b,*]
[a]Department of Applied Chemistry, Graduate School of Engineering, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan.
[b]Institute for Advanced Study, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan.
Email: yasuda@ifrc.kyushu-u.ac.jp

Keywords: indoor organic photovoltaics, wide-bandgap, donor polymer.

With the emergence of low-power electronics, the Internet of Things (IoT) is rapidly developing and spreading. In the next decade, over billions or trillions of IoT devices will be implemented in our society, creating demand for distributed power sources. Energy harvesting technologies that are capable of harvesting environmental energies including light, heat, and mechanical vibrations, have attracted significant research interest. Organic photovoltaics (OPVs) are considered to be ideal candidates for off-grid energy sources by harvesting indoor light due to their characteristics of light weight, flexibility, and high optical response ability, thereby reducing the use of conventional batteries. To achieve high-efficiency OPVs under indoor conditions, matching the absorption of OPV materials with the indoor lighting (e.g., white LED light) is critical. Besides, maintaining a high open-circuit voltage (V_{oc}) is important for indoor OPVs because of an inevitable V_{oc} loss under dim-light conditions[1]. Therefore, OPVs with high V_{oc} under outdoor conditions usually exhibit good performance in indoor conditions. Recently, electron-deficient azaheterocyclic units have been proven to be useful for designing wide-bandgap π-conjugated polymers with deep highest occupied molecular orbital (HOMO) levels[2]. Because the V_{oc} of OPVs is dependent on the energy offset between the donor's HOMO and acceptor's lowest unoccupied molecular orbital (LUMO) level, the use of π-conjugated polymers with deep HOMO levels is beneficial for indoor OPVs. In this study, we designed and synthesized a new benzodithiophene (BDT)-based wide-bandgap π-conjugated polymer containing electron-deficient pyrimido[5,4-d]pyrimidine (PyPy) units, namely, P(PyPy-BDT) (Fig. 1a). P(PyPy-BDT) is proved to have a wide-bandgap with a high photoabsorptivity in the range of 400–600 nm, which is highly complementary to the absorption of non-fullerene acceptors (Fig. 1b). As expected, the P(PyPy-BDT):IT-4F-based OPV achieved a PCE of 9.3% under 1-sun AM 1.5G condition, while the P(PyPy-BDT):IO-4F-based OPV yielded a PCE of 20.0% under indoor LED conditions at an illuminance of 1000 lx (Fig. 1c).

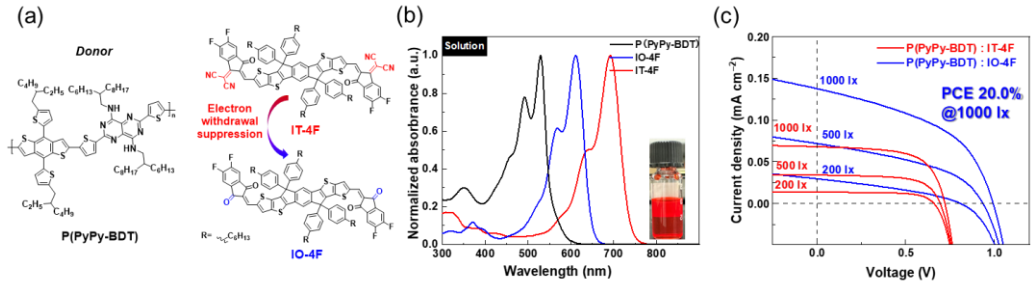


Fig. 1. (a) Molecular structures of P(PyPy-BDT) polymer donor and IT-4F/IO-4F acceptors, (b) absorption of molecules, and (c) variation of PCE against the incident LED light intensity in the range of 200–1000 lx.

[References]

(1) S. Hwang and T. Yasuda, *Polym. J.* **2023**, *55*, 297-316.

(2) T. Zhang, C. An, Y. Cui, J. Zhang, P. Bi, C. Yang, S. Zhang, and J. Hou, *Adv. Mater.*, **2024**, *34*, 2105803.

[Poster 01-33]

Computational Study on *t*BP Free Hole Transport Layer for Stable and Efficient Perovskite Solar Cells

Dong Gyu Lee[a,#], Yun Seop Shin[b], Jaehwi Lee[b], Dong Suk Kim[b], Tae Kyung Lee[a,*]
[a]Department of Materials Engineering and Convergence Technology, Gyeongsang National University (GNU), Jinju 52828, Republic of Korea.
[b]Graduate School of Carbon Neutrality, Ulsan National Institute of Science and Technology (UNIST), Ulsan 44919, Republic of Korea.
Email: tklee8865@gnu.ac.kr

Keywords: Perovskite solar cells, Hole transport layer, *t*BP free, Ethylene carbonate, Molecular simulations

The thermal instability and gradual de-doping of conventional 4-tert-butylpyridine (*t*BP)-containing hole transport layers (HTLs) remain among the most critical obstacles that hinder the long-term operational stability of perovskite solar cells (PSCs). Although *t*BP has been widely employed as an additive to improve hole mobility and device performance, its intrinsic volatility and poor thermal tolerance accelerate the degradation of the HTL and, in turn, limit device lifetime. This study presents a comprehensive molecular-level strategy for designing a next-generation *t*BP-free HTL that achieves high power conversion efficiency and long-term durability. Specifically, we introduce ethylene carbonate (EC) as a functional additive, which, due to its strongly electronegative carbonyl group, enables the stable coordination with Li^+ ions to form robust solvation complexes. This coordination not only enhances the solubility of lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) but also promotes efficient *p*-type doping of the HTL even in the complete absence of *t*BP. Atomic-scale simulations provided evidence of the strong binding affinity between EC and Li^+ as well as the resulting stabilization of the local electronic environment, thereby corroborating the experimental observation of enhanced doping and thermal robustness. Beyond the improvement in doping efficiency, incorporating EC significantly elevates the glass transition temperature of the HTL matrix, thereby imparting enhanced resistance against thermal stress and mitigating morphological instabilities during device operation. This work ultimately offers a promising pathway toward realizing PSCs that combine high efficiency with superior operational stability, addressing a key barrier to their commercial viability.

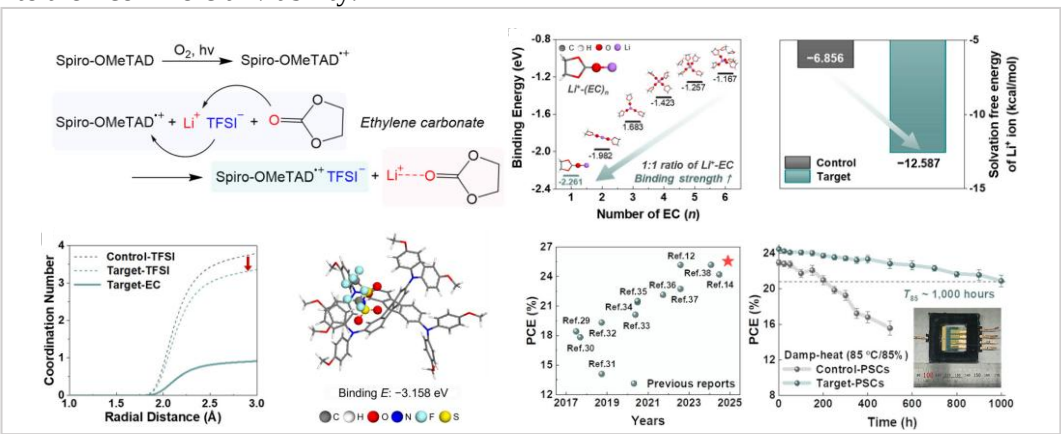


Fig. 1. Doping mechanism of EC-incorporated spiro-OMeTAD HTLs and related results[1].

[Reference]

(1) Shin, Y.; Lee, J.; Lee, D.; Song, J.; Seo, J.; Roe, J.; Sung, M.; Park, S.; Shin, G.; Yeop, J.; Lee, D.; Yoon, C.; Kim, M.; Son, J.; Kim, G.; Cho, S.; Kim, J.; Lee, T.; Kim, D. *Energy Environ. Sci.* **2025**, *18* (7), 3269– 3277

[Poster 01-34]

Thermodynamic Analysis of $YCl_3/ZnCl_2$ Additives for Improving Efficiency and Long-Term Stability of Quasi-2D Perovskite LEDs

Sang Wook Patk[a,#], Gwang Yong Shin[a], Gi-Hwan Kim[a], Tae Kyung Lee[a,*]
[a]Department of Materials Engineering and Convergence Technology, Gyeongsang National University (GNU), Jinju 52828, Republic of Korea.
Email: tklee8865@gnu.ac.kr

Keywords: Perovskite light-emitting diodes, Quasi-2D perovskite, Defect passivation, Precursor interaction, Density functional theory

Quasi-two-dimensional (Q-2D) perovskites have garnered significant interest as next-generation light-emitting diodes (LEDs) due to their remarkable optoelectronic properties and efficient exciton funneling behavior. Nevertheless, uncontrolled phase distribution and associated defect states continue to cause severe nonradiative losses and hinder device performance. In this work, we present a comprehensive theoretical investigation into the thermodynamic roles of YCl_3 and $ZnCl_2$ additives in modulating phase distribution and defect chemistry of Q-2D perovskites. Density functional theory calculations reveal distinct additive–precursor interactions, where $ZnCl_2$ strongly suppresses the formation of unwanted 3D phases, while YCl_3 acts on Pb^{2+} and Cs^+, enabling effective charge-compensated defect passivation. These complementary mechanisms are further supported by formation energy and binding energy calculations, providing molecular-level insights into phase stabilization and defect suppression. As a result of this synergistic additive strategy, Q-2D perovskite LEDs exhibited a maximum external quantum efficiency of 8.87% and an operational stability (T_{50}) of 27.78 min under constant current driving, representing significant improvements in both efficiency and durability. This study highlights the importance of thermodynamic control through rational additive design and demonstrates the potential of $YCl_3/ZnCl_2$ co-additives in advancing stable and efficient Q-2D perovskite optoelectronics.

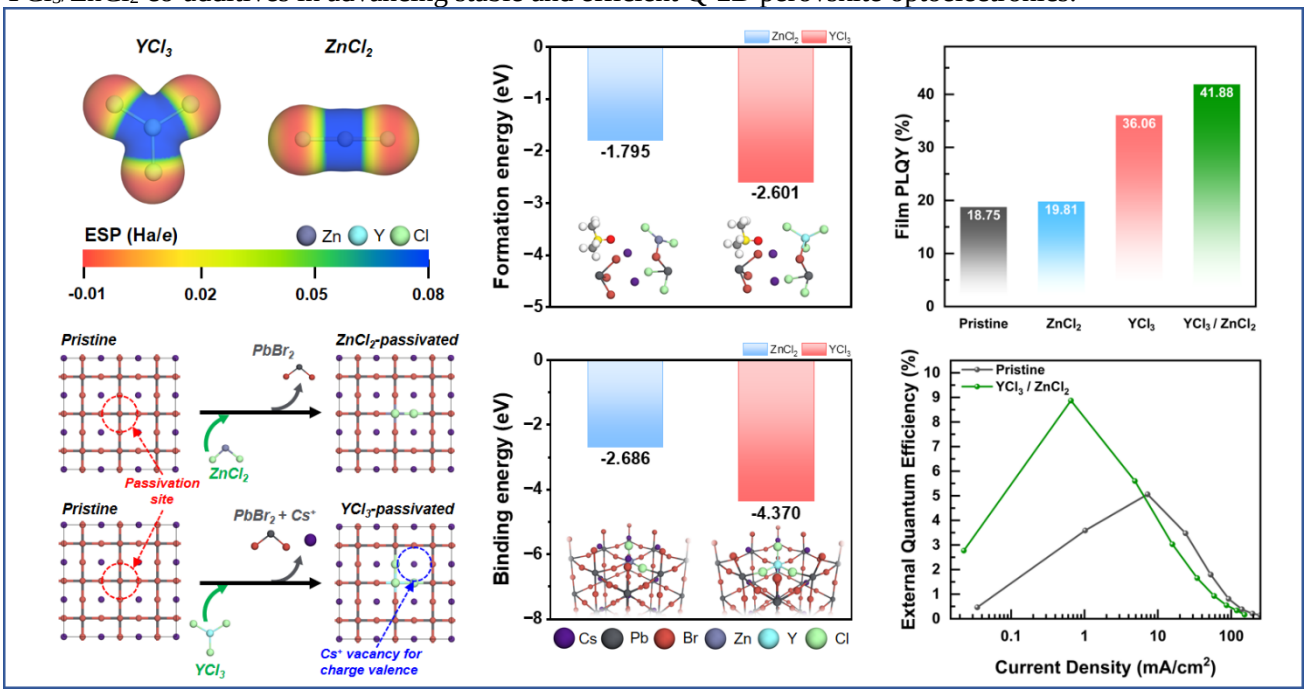


Fig. 1. Synergistic roles of YCl_3 and $ZnCl_2$ in phase control, defect passivation, and performance enhancement of Q-2D perovskite LEDs.

[Poster 01-35]

Computational Insights into Alkyl Diammonium Ligands Considering Strain-Induced Inhomogeneity in All-Perovskite Tandem Solar Cells

Jun Hyeok Choi[a,#], Hansol Park[b], Dong Gyu Lee[a], Yoonsung Kim[c], Hui Joon Park[b], Tae Kyung Lee[a,*]
[a]Department of Materials Engineering and Convergence Technology, Gyeongsang National University (GNU), Jinju 52828, Republic of Korea.
[b]Department of Organic and Nano Engineering & Human-Tech Convergence Program, Hanyang University, Seoul 04763, Republic of Korea.
[c]Department of Semiconductor Engineering, Hanyang University, Seoul 04763, Republic of Korea.
Email: tklee8865@gnu.ac.kr

Keywords: Density functional theory calculations, All-perovskite tandem solar cells, Alkyl diammonium ligands, Defect passivation, Vertical inhomogeneity

All-perovskite tandem solar cells represent a promising photovoltaic technology capable of surpassing the Shockley-Queisser efficiency limit of single-junction devices. However, their performance is still limited by interfacial nonradiative recombination, which is often aggravated by vertical inhomogeneity in the perovskite absorber layer. Such inhomogeneity generates localized defect states, hindering carrier transport and reducing device efficiency. To overcome this challenge, we proposed a dual-surface modification strategy employing alkyl diammonium (DA) ligands to passivate vertically inhomogeneous perovskite films. With two terminal NH_3^+ groups, alkyl DA ligands can simultaneously occupy adjacent A-site vacancies, suppressing defect formation at both interfaces. Based on the Boltzmann distribution ratio, we demonstrated that linear passivation extends the passivation region more broadly than cross passivation. Moreover, linear passivation is found to be thermodynamically preferred for butane-1,4-diammonium in wide-bandgap perovskites and for propane-1,3-diammonium in low-bandgap perovskites. Ligand chain length regulates vertical inhomogeneity at the bottom interface, further influencing defect suppression. These insights reveal the key role of ligand configuration and chain engineering in interfacial stabilization and provide molecular-level design rules for high-performance all-perovskite tandem solar cells.

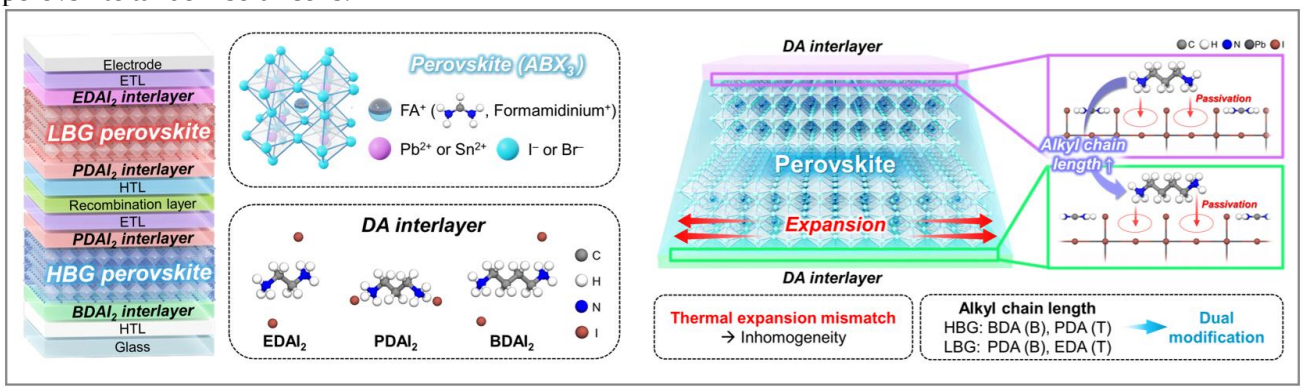


Fig. 1. All-perovskite tandem solar cells and management of vertical inhomogeneity.

[Poster 01-36]

Molecular-Level Insights into Doping Mechanisms of Conjugated Polymers

Yubhin Cho[a,#], Sang Eun Yoon[b], Jaemin Im[a], Hyun Ho Choi[a], Jong H. Kim[b] and Tae Kyung Lee[a,*]
[a]Department of Materials Engineering and Convergence Technology, Gyeongsang National University, Jinju 52828, Republic of Korea
[b]Department of Molecular Science and Technology, Ajou University, Suwon 16499, Republic of Korea
Email: Email: tklee8865@gnu.ac.kr

Keywords: Conjugated polymer, Molecular doping, Doping reaction mechanism, Integer charge transfer, Molecular simulation

With the growing demand for organic semiconductor applications, enhancing the performance of conjugated polymer (CP)-based semiconductors that are flexible, impact-resistant, and practical has become essential. Despite the significance of chemical doping for improving device performance, theoretical understanding of the underlying doping mechanisms is still limited. Here, we conducted density functional theory calculations to study CPs and dopant substitution at atomic and molecular levels. We investigated the electronic structure properties associated with doping mechanisms, dopant behavior, and charge transport. Depending on the type of dopant (F_4TNCQ and $AuBr_3$), the dominant doping system was identified through binding energy analysis. We confirmed that charge transfer complex (CTC) doping was the dominant doping system, rather than integer charge transfer (ICT) doping. In addition, hole doping was quantitatively evaluated based on atomic charge. Our study reveals that, unlike earlier reports dominated by CTC doping, ICT doping emerges as the prevailing mechanism during dopant substitution. These theoretical insights highlight doping processes and provide a foundation for designing next-generation CP-based semiconductors.

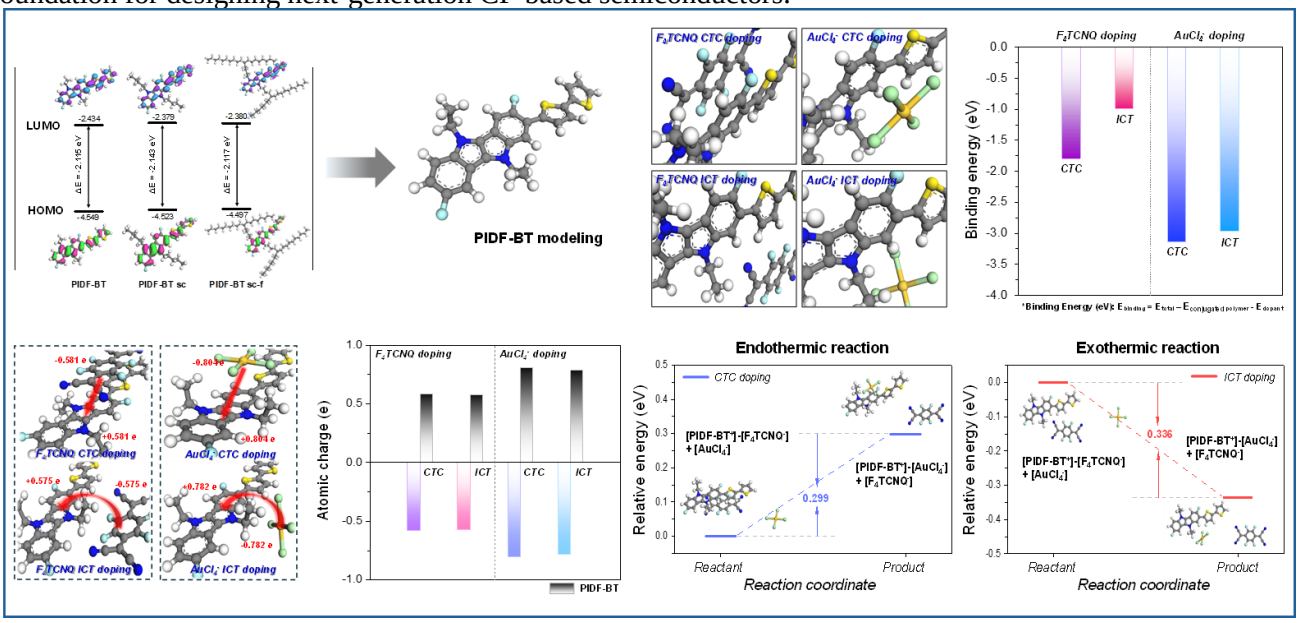


Fig. 1. Identification of the doping mechanism of PIDF-BT with F_4TCNQ and $AuBr_3$

[Poster 01-37]

Transformable and Adhesive Nanomembranes for Skin-conformal and High-Performance Soft Bioelectronics

Daeyeon Lee[a,#], Hyunjin Jung[b,c], Donghee Son[b,c,d,*], and BongSoo Kim[a,e,f,*]
[a]Department of Chemistry, Ulsan National Institute of Science and Technology (UNIST), Ulsan 44919, Republic of Korea
[b]Department of Electrical and Computer Engineering, Sungkyunkwan University (SKKU), Suwon 16419, Republic of Korea
[c]Center for Neuroscience Imaging Research, Institute for Basic Science, Suwon 16419, Republic of Korea
[d]Department of Artificial Intelligence System Engineering, Sungkyunkwan University (SKKU), Suwon 16419, Republic of Korea
[e]Graduate School of Semiconductor Materials and Device Engineering, Ulsan National Institute of Science and Technology (UNIST), Ulsan 44919, Republic of Korea
[f]Graduate School of Carbon Neutrality, Ulsan National Institute of Science and Technology (UNIST), Ulsan 44919, Republic of Korea
Email: bongsoo@unist.ac.kr, daniel3600@g.skku.edu

Keywords: Soft Bioelectronics, Organic Electrochemical Transistor (OECT), Semiconducting polymer, selenium substitution

Soft bioelectronics require devices that seamlessly interface with living tissues for stable, high-fidelity monitoring of biological signals.[1] However, a fundamental dilemma exists: platforms must be robust enough for handling, yet soft enough to avoid damaging delicate tissue. To overcome this, we present a Transformable and imperceptible Hydrogel-elastomer adhesive bilayer based on Ionic-electronic conductive Nanomembranes (THIN, thickness = 350 nm), composed of a 260 nm hydrophilic, tissue-adhesive hydrogel layer (catechol-conjugated alginate, Alg-CA) and a 90 nm hydrophobic semiconducting polymer layer (P(g2T2-Se)). THIN is rigid when dry and instantly becomes soft and adhesive upon hydration. This instantaneous rigid-to-soft transformation, with hardness dropping from 1.35 GPa to 0.035 GPa, allows for self-supporting manipulation in the dry state and pressure-free, spontaneous conformal adhesion to dynamic biological surfaces. The electrical performance is driven by P(g2T2-Se), where selenium substitution enhances backbone planarity and intermolecular interactions. This design boosts both charge mobility and volumetric capacitance, resulting in a superior mixed ionic-electronic conduction with a figure of merit (μC^*) of 1,034 $F \cdot cm^{-1} \cdot V^{-1} \cdot s^{-1}$, about four times higher than its sulfur-based counterpart. When integrated into an organic electrochemical transistor (OECT), THIN maintains stable performance under large mechanical strain (up to 200%) and repeated abrasion. We validated the platform *in vivo* by recording high-fidelity epicardial electrograms (EGM), electromyograms (EMG), and electrocorticograms (ECoG) in rats. The devices showed excellent long-term stability and biocompatibility, with no significant inflammatory or fibrotic response after four weeks of implantation. Collectively, THIN provides a practical, high-performance strategy for imperceptible bioelectronic interfaces, paving the way for next-generation implantable diagnostics and skin-conformal wearable systems.

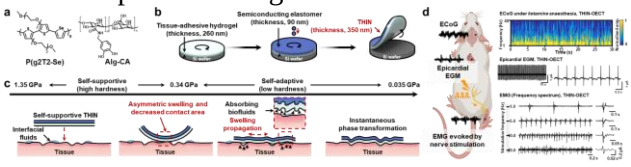


Fig. 1. THIN bioelectronic platform. (a) chemical structure. (b) Fabrication process of THIN, (c) Self-adaptation mechanism of THIN. and (d) *In vivo* validation in a rat model, showing high-fidelity recording

[References]

(1) Khodagholy, D., et al. *Nat. Commun.*, **2013**, *4* (1), 1575.

[Poster 01-38]

Understanding Redox Mechanism and Ion Transport in NDI-Based Polymers via Multiscale Simulations

Hyeonsu Son[a,#], Soyoung Kim[b], Wonho Lee[b], Tae Kyung Lee[a,*]
[a]Department of Materials Engineering and Convergence Technology, Gyeongsang National University (GNU), Jinju 52828, Republic of Korea.
[b]Department of Polymer Science and Engineering, Kumoh National Institute of Technology (KIT), Gumi 39177, Republic of Korea.
Email: tklee8865@gnu.ac.kr

Keywords: Lithium-ion batteries, Organic cathode, Reduction mechanism, Density functional theory, Molecular dynamics

Naphthalenediimide (NDI)-based polymers are considered promising sustainable materials for lithium-ion batteries due to their stable two-electron redox activity, structural tunability, and outstanding cycling performance. However, depending on the electron-donating ability and conjugation length of the donor linkage, these polymers can exhibit either a one-step two-electron reduction or a stepwise single-electron reduction mechanism, resulting in distinct redox characteristics and energy efficiencies. In this study, we conducted multiscale simulations to elucidate how variations in polymer backbone structure influence the redox behavior and ion transport properties of three NDI-based conjugated systems: P(NDI2OD-T2) (T2), P(NDI2BO-T) (T), and P(NDI2BO-V) (V). Density functional theory calculations revealed that the energy gap between LUMO and LUMO+1 increases from T2 to V, correlating with a transition from concerted to stepwise electron transfer. Furthermore, electrostatic potential analysis indicated stronger charge localization in the V system upon reduction, supporting its sequential redox pathway. To further investigate the structural impact on Li^+ transport, molecular dynamics simulations were performed to estimate the density of each polymer system. The V system exhibited the lowest packing density, suggesting a more amorphous morphology compared to T2 and T. This lower density was found to facilitate enhanced Li^+ ion diffusion, as supported by experimentally observed diffusion coefficients. Our findings offer molecular-level insights into how the structure of redox-active polymers affects their electrochemical performance, contributing to better understanding of organic cathodes.

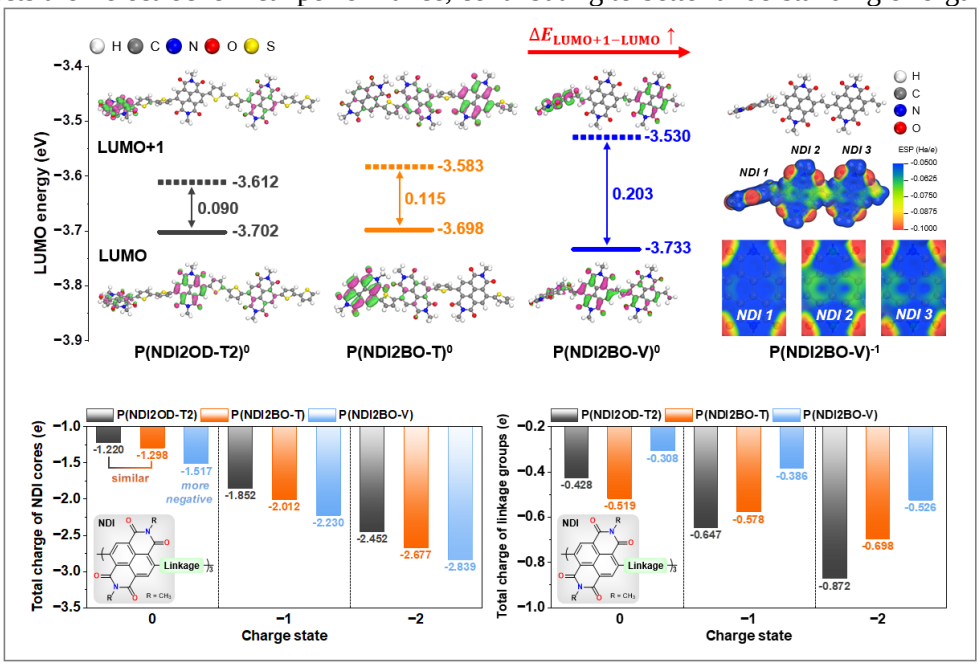


Fig. 1. Electronic characteristics of NDI-based conjugated systems, including orbital energy levels, electrostatic potential, and atomic charge distributions.

[Poster 01-39]

Tailored Thermoelectric Performance of Tetrasubstituted Thieno[3,2-b]thiophene-Based Small Molecule/Carbon Nanotube Composite Materials

Yu-Chuan Liu[a,#], Meng-Ju Tsai[b], Ken-Tsung Wong[b,c,*], Cheng-Liang Liu[a,d,e,*]
[a]Department of Materials Science and Engineering, National Taiwan University, Taipei 10617, Taiwan
[b]Department of Chemistry, National Taiwan University, Taipei 10617, Taiwan
[c]Institute of Atomic and Molecular Sciences, Academia Sinica, Taipei 10167, Taiwan
[d]Institute of Polymer Science and Engineering, National Taiwan University, Taipei 10617, Taiwan
[e]Advanced Research Center for Green Materials Science and Technology, National Taiwan University, Taipei 10617, Taiwan
Email: liucl@ntu.edu.tw

Keywords: thermoelectric, organic small molecule, nanocomposite, single-walled carbon nanotube

Thermoelectric (TE) materials, which can directly convert waste heat into electricity, show significant potential for energy applications. Compared to polymers, which often suffer from issues of purity control, organic small molecules (OSMs) offer well-defined and tunable structures, providing advantages for investigating structure–property relationships when blended with carbon nanotubes (CNTs). In this study, two isomeric small molecules featuring a thieno[3,2-b]thiophene core, denoted as H3 and H4, were selected to fabricate OSM/CNT composite films. The impact of small molecule properties, such as energy levels, carrier concentration, and intermolecular interactions with CNTs and solvent molecules, on TE performance was explored. Upon optimizing the composition, the H4/CNT composite film exhibited the best p-type TE performance with a power factor (PF) of 461.06 ± 33.07 μW m^{-1} K^{-2}, while the H3/CNT composite film demonstrated superior n-type performance with a PF of 333.77 ± 33.02 μW m^{-1} K^{-2}. An integrated p–n thermoelectric generator is fabricated using these two optimized nanocomposites. This device is shown to provide an output power of 27.0 nW at a temperature difference of 30 K. The findings elucidate the critical role of molecular structures and energy level alignment in determining the thermoelectric performance of carbon nanotube composites, thereby offering valuable insights for the rational design of advanced TE materials for wearable thermoelectric generator applications.

[Poster 01-40]

Solution-processed Ag_2S thin films exhibiting low-voltage, high-performance bipolar resistive switching

Yoonjin Cho[a,#], Jaesung Son[a,*]
[a]Pohang University of Science and Technology, Pohang, Republic of Korea
Email: sonjs@postech.ac.kr

Keywords: Solution process, Resistive switching memory, Ag_2S, semiconductor thin film

Ag_2S thin-film resistive random access memory (RRAM) devices were developed through a cost-effective solution-based approach. The process utilized a molecular Ag_2S complex solution, prepared via chemical reduction in an amine–thiol cosolvent system, which enabled wafer-scale film deposition. These devices demonstrated reliable bipolar resistive switching with an excellent Ion/Ioff ratio of about 10^6, forming-free operation, and low set/reset voltages within ±1 V, validating their stable non-volatile memory characteristics. The switching mechanism is ascribed to the controlled formation and dissolution of Ag filaments inside the Ag_2S matrix. Furthermore, performance was enhanced by applying low-temperature annealing and antisolvent engineering, which proved effective in improving the surface morphology of solution-processed thin films.

[Poster 01-41]

Angle-dependent magneto-photoconductance modulated by a photoinduced fringe field-like effect in non-ferromagnetic pentacene/fullerene planar heterojunction

Anas Mujahid[a,#], Nidya Chitraningrum[a], Tzung-Fang Guo[a,b,*]
[a]Department of Photonics, National Cheng Kung University, 70101, Tainan, Taiwan, ROC.
[b]Advanced Optoelectronic Technology Center, National Cheng Kung University, 70101 Tainan, Taiwan, ROC
Email: guotf@mail.ncku.edu.tw

Keywords: Planar heterojunction photodiode, magneto-photoconductance, photoinduced magnetic dipole, spin-mixing.

Organic semiconductors are generally considered non-ferromagnetic due to the absence of intrinsic magnetic dipoles. In this study, we report photoinduced magnetic dipole-like behavior in a ferromagnet-free pentacene/fullerene (C_{60}) planar heterojunction (PHJ) organic photodiode. A static interfacial dipole forms at the pentacene/C_{60} interface due to charge separation. Upon photoexcitation, this dipole generates a spatially varying local electric field, a fringe field-like effect arising from the dynamic distribution of photogenerated carriers. This emergent field modulates spin-dependent charge transport, leading to a distinctive angle-dependent magnetophotocurrent (MPC) response. Notably, a low-field MPC feature (<100 Oe) appears under a magnetic field aligned parallel to the device current, serving as direct evidence of fringe-field-induced modulation.[1] Such behavior remains absent in bulk heterojunction devices, underscoring the critical role of the planar interface. These results display the potential to harness photoinduced fringe-field-like effects in non-ferromagnetic materials, offering a compelling direction to avoid the instability and degradation challenges associated with conventional magnetic systems.[2]

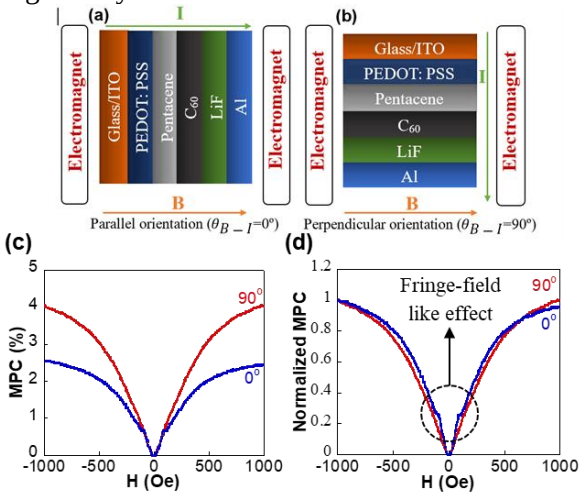


Fig. 1. The pentacene/C_{60} PHJ photodiode device structure configuration at (a) parallel and (b) perpendicular to the applied magnetic field concerning current (I) for MPC measurement. (c) The MPC and (d) the normalized MPC of pentacene/C_{60} PHJ-based photodiode for parallel (blue line) and perpendicular (red line) measured at 0 V.

[Reference]

(1) Macia, F., Wang, F., Harmon, N.J., Kent, A.D., Wohlgenannt, M., Flatté, M.E., *Nat. Commun.*, **2014**, *5*, 3609.

(2) Liu, C., Chen, Z., Du, H., Yu, Y., Ren, J., Fan, J., Han, S., Pang, Z., *J. Mater. Chem. C*, **2023**, *11*, 11262.

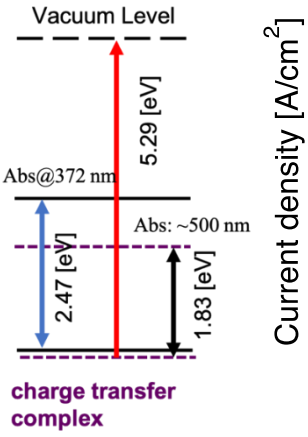
[Poster 01-42]

Doping Effect and Electrical Behavior of Spiro-MeOTAD Films

Takatoshi Hayase, Tetsuya Honda, Noriyuki Taoka, Yusuke Ichino and Yoshiyuki Seike, Tatsuo Mori[#,*]
Aichi Institute of Technology, Department of Electrical Engineering
1247, Yachigusa, Yakusa-cho, Toyota 470-0392, Japan
Email: t2mori@aitech.ac.jp

Keywords: perovskite solar cell, hole transport layer, spiro-MeOTAD, doping, TPFB

Spiro-MeOTAD is widely used as a hole transport material for perovskite solar cells since the first report[1]. Since a spiro-MeOTAD has 4 tryphenyl amine groups which act as a hole transport site, it has an excellent hole conductor. In addition, spiro-MeOTAD has a high solubility because of steric hindrance of triphenyl amine groups and spiro group. In solar cells not applied with external voltage, however, the conductivity of undoped spiro-MeOTAD is low and then doped spiro-MeOTAD is generally used as a hole conductor. Bis(trifluoromethanesulfonyl)imide Lithium (LiTFSI) is most popular and the other oxydants such as F4TCNQ, TBP etc. are also reported[2]. In this study, we discuss film properties and electrical conduction of undoped and TPFB-doped spiro-MeOTAD specimens[3]. The absorbance of spiro-MeOTAD shows the peak of 372 nm and that of TPFB-doped spiro-MeOTAD shows the additional peak around 500 nm, too. The latter is thought to be due to the charge-transfer complex with spiro-MeOTAD and TPFB (oxidation of spiro-MeOTAD). The ionization potentials of undoped and TPFB-doped spiro-MeOTAD films are estimated to be 5.14-5.15 eV and 5.29-5.34 eV, respectively, using AC-3 (Riken Keiki Co.). The energy diagram is proposed in Fig. 1. Fig. 2 shows the current density – voltage characteristics of ITO/TPFB-doped spiro-MeOTAD (183 nm)/Al and ITO/undoped spiro-MeOTAD (156 nm)/Al. Although the current in the reverse bias (left area) is negative, the reverse current describes as the magnitude in order to compare with the forward current. The forward current is max 2 orders higher than the reverse current under a same absolute voltage. The current in doped spiro-MeOTAD specimen is 3 orders higher than that in undoped spiro-MeOTAD specimen.



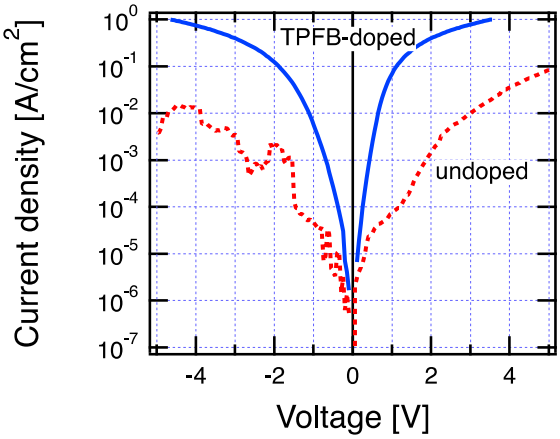


Fig. 1. Proposed energy diagram of TPFB-doped spiro-MeOTAD. Fig. 2. J-V curves of undoped and doped specimens.

[References]

(1) M. M. Lee, J. Teuscher, T. Miyasaka, T. N. Murakami, and H. J. Snaith, *Science*, **2012,** *338*, 643.

(2) J. Liu, W. Liu, E. Aydin, G. T. Harrison, H. Isikgor, X. Yang, A. S. Subbiah, and S. De Wolf, *ACS Appl. Mater. Interfaces*, **2020,** *12*, 23874.

(3) T. Mori, T. Honda, N. Taoka, Y. Ichino, Y. Seike, T. Mori, *Proc. of AM-FPD2024*, Kyoto, P_18.

[Poster 01-43]

Unanticipated Interfacial Redox Reaction in the NiOx Transport Layer of Perovskite Light-Emitting Diodes

Thi-Hoai Do[a,#], Aswaghosh Loganathan[a], Yun-Han Wu[a], Yaw-Shyan Fu[b], Tzung-Fang Guo[a,c,d,e,*]
[a]Department of Photonics, National Cheng Kung University, Tainan 701, TW
[b]Department of Greenergy Technology, National University of Tainan, Tainan 700, TW
[c]Academy of Innovative Semiconductor and Sustainable Manufacturing, National Cheng Kung University, Tainan 701, TW
[d]Research Center for Applied Sciences (RCAS), Academia Sinica, Taipei 115, TW
[e]Taiwan Research Center for Critical Issues (RCCI), Academia Sinica, Tainan 711, TW
Email: guotf@mail.ncku.edu.tw, guotf@as.edu.tw

Keywords: metallic lead, NiO_x/perovskite interface, bias-induced performance, oxidation-reduction reaction.

This study reveals an unanticipated interfacial redox reaction between the nickel oxide (NiO_x) hole transport layer and perovskite active layer in organolead halide perovskite light-emitting diodes (PeLEDs). Specifically, metallic nickel (Ni^0) present in the NiO_x layer undergoes oxidation while lead ions (Pb^{2+}) from the perovskite precursor are reduced, forming nickel (II) ions (Ni^{2+}) and metallic lead (Pb^0), as confirmed by X-ray photoelectron spectroscopy (XPS) (Figure 1a,b). The formation of Pb^0, a well-known luminescence quenching center, is correlated with the significantly suppressed photoluminescence (PL) before biasing (Figure 1d) and the pronounced electroluminescence (EL) overshoot observed at the onset of electrical excitation (Figure 1e).(1) Introduction of an electrode interlayer, such as a polyvinyl carbazole (PVK), prevents direct contact between NiO_x and the perovskite thereby effectively suppresses the detrimental redox reaction between them (Figure 1b,c). This electrode interfacial modification eliminates Pb^0 formation, mitigates luminescence quenching, and suppresses EL overshoot (Figure 1d,e). Our findings offer critical insights into bias-induced luminescence enhancement phenomena and present a reliable, scalable strategy to mitigate these phenomena, contributing to the development of advanced PeLEDs.

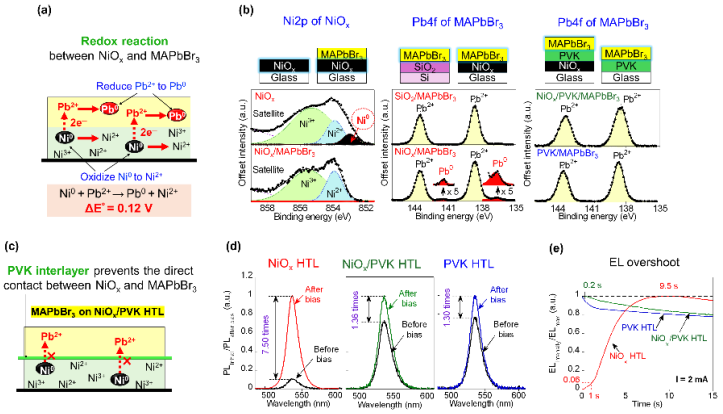


Fig. 1. (a) Schematic for redox reaction between NiO_x and $MAPbBr_3$. (b) XPS study for perovskite and different substrates (NiO_x, SiO_2, PVK, NiO_x/PVK). (c) Schematic of the PVK buffer layer that prevents the redox reaction between NiO_x and perovskite. (d) Bias-induced PL behavior of $MAPbBr_3$ with different hole transporting layers. (e) The EL overshoot behavior of $MAPbBr_3$ with different hole transporting layers.

[References]

(1) T. L. Shen, A. Loganathan, T. H. Do, C.-M. Wu, Y.-T. Chen, Z.-J. Chen, N.-C. Chiu, C.-H. Shih, H.-C. Wang, J.-H. Chou, Y.-Y. Hsu, C.-C. Liu, Y.-C. Chang, Y.-S. Fu, W.-C. Lai, P. Chen, T.-C. Wen, T.-F. Guo, *Adv. Opt. Mater.* **2022**, *10*, 2101439.

[Poster 01-44]

Physical vapor co-deposition of lead-free halide perovskite $CsSn_{1-x}Zn_xBr_3$ and fabrication of inverted solar cell

Hanbo Jung[a,#], Zihao Liu[b], Masato Sotome[c], Kazuteru Nonomura[c], Gaurav Kapil[d], Shuji Hayase[d], Takashi Kondo[b,c], Toshinori Matsushima[a], Zhanglin Guo[a,*]

[a]I[2]CNER Kyushu Univ., [b]Fac. Eng. Univ. of Tokyo, [c]RCAST Univ. of Tokyo, Univ. of Electro-Communications[d]

Email: Guo.zhanglin.903@m.kyushu-u.ac.jp

Keywords: Sn-based perovskite solar cells, All-inorganic perovskites, New alloy, Energy level alignment

Metal halide perovskites (MHPs) have attracted research attention since the report of $CH_3NH_3PbI_3$ solar cell [1]. However, the practical application of MHP solar cells has been hindered by the toxicity associated with lead (Pb). Researchers have attempted to substitute the B-site Pb-ion with tin (Sn)-ion with lower health risk. Among them Sn-based MHP solar cell with $CH(NH_2)_2SnI_3$ have recently been reported to show high power conversion efficiencies (PCEs) of 14% [2]. Since MHPs with organic cations often exhibit poor thermal stability due to the volatile nature of the organic cation, there is growing interest in all-inorganic perovskites $CsSnX_3$ (X= Cl, Br, I) as the alternatives. Several studies have reported improvements in the morphology of Sn perovskites through compositional engineering. Among them, Zinc (Zn) ion has been reported to enhance the environmental stability of $CsSnI_3$ films by acting as a reducing agent [3]. However, no studies have yet explored the fabrication of $CsSnBr_3$ thin films mixed with other elements. In our previous report, we found that new alloy of $CsSn_{1-x}Zn_xBr_3$ thin films were successfully synthesized varying with x = 0, 0.01, 0.02, 0.04 (abbreviated as Pure, 1Zn, 2Zn, and 4Zn respectively), leading to improved-quality alloy [4]. In this study, we fabricated the inverted solar cell structure [ITO/PEDOT:PSS/$CsSn_{1-x}Zn_xBr_3$/C_{60}/BCP/Ag]. The ionization energy of $CsSn_{1-x}Zn_xBr_3$ thin films decreased with increasing Zn content, leading to improved energy level alignment at the interfaces in solar cells [Fig. 1(a)]. The energy gap difference between perovskite/C_{60} and perovskite/PEDOT:PSS for the 4Zn sample was expected to be 0.05 eV. This minimized energy gap difference fostered balanced charge extraction, enhancing overall solar cell performance [PCE = 2.59%, V_{OC} (0.35 V), J_{SC} (13.99 mA/cm^2), and Fill factor (FF : 54%)] [Fig. 1(b)]. It was comparable to the previous study's solar cell with much amount of SnF_2 addition (30% of chemical composition) [5]. Long-term stability, with $CsSn_{1-x}Zn_xBr_3$ devices were tested at 25°C and 60% humidity [Fig. 1(c)]. The 4Zn device maintained 96% of V_{OC}, 86% of J_{SC}, and 91% of FF, resulting in the keep of 83% of its initial PCE, outperforming previously reported $CsSnBr_3$ solar cells [5].

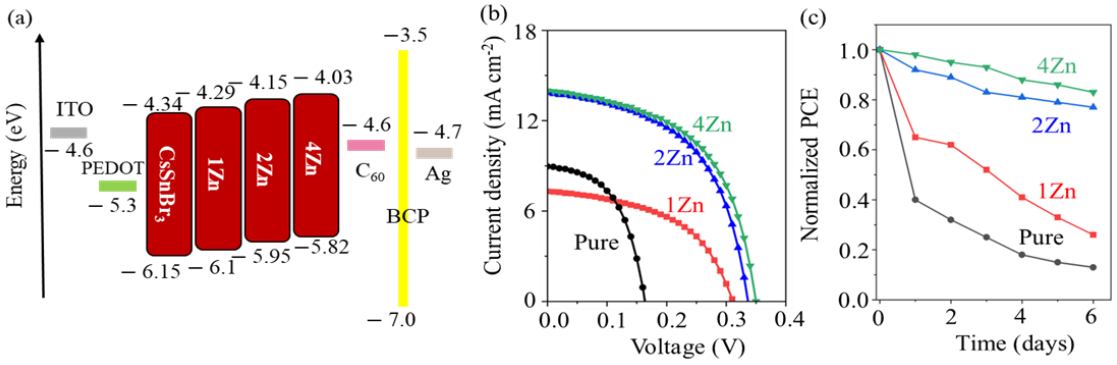


Fig.1. (a) Energy diagram, (b) best *J*-*V* curves, and (c) time evolution of normalized PCE of the PSCs.

[References]

(1) A. Kojima *et al*., *J. Am. Chem. Soc*. **2009**, *131*, 6050.

(2) L. Wang *et al*., *ACS Energy Lett*. **2022,** *7*, 3703.

(3) W. Zhang *et al*., *Adv. Sci*. **2022**, *9*, 2106054.

(4) H. Jung *et al*., *Jpn. J. Appl. Phys*. **2024, 63** 01SP24.

(5) S. Gupta *et al*., *ACS Energy Lett*. **2016**, *1*, 1028.

[Poster 01-45]

Photon Recycling Effects and Electroluminescence in Perovskite Solar Cells

Jeongheon Park[a,#], Changsoon Cho[a,*]
[a]Department of Materials Science and Engineering, Pohang University of Science and Technology, Pohang, Korea
Email: cho23@postech.ac.kr

Keywords: Perovskite solar cells, Electroluminescence, Photon recycling

Perovskite solar cells (PSCs) have emerged as a next-generation photovoltaic technology owing to their high extinction coefficient and excellent charge-transport properties. Recent advances have significantly improved light absorption and charge collection under short-circuit conditions, bringing PSCs closer to the detailed-balance limit. To ultimately reach this limit, PSCs must function as nearly perfect emitters with highly efficient electroluminescence (EL). State-of-the-art PSCs already exhibit electroluminescence quantum efficiencies (ELQEs) exceeding 8%, surpassing the classical ray-optics outcoupling limit of $1/2n^2$ (where $n \approx 2.5$ is the refractive index of the perovskite). Here, we review our recent studies analyzing the effects of photon recycling, which allow PSCs to overcome the classical ELQE limit and approach the detailed-balance efficiency limit.

Metal halide perovskites exhibit strong photon recycling due to the substantial overlap between their emission and absorption spectra. We quantified its impact in a highly radiative n-i-p perovskite solar cell with an efficiency of 26.0%. This device demonstrates an ELQE as high as 19.7%, well beyond the classical limit. Our optical model reveals that photon recycling enhances external emission by 32%, contributing to an additional photovoltage of 1.2 mV. This study highlights the importance of advanced optical designs for next-generation PSCs to maximize the benefits of photon recycling and, consequently, electroluminescence.

[Poster 01-46]

Patternable Micro Electric Wires: Liquid Metal-Elastomer Core-Shell Electrodes

Safina Saidova[a,#], Yeonjee Jeon[b], Jung-Yong Lee[b,*]
[a]Department of Aerospace Engineering, KAIST, Daejeon 34141, Republic of Korea
[b]Department of Electrical Engineering, KAIST, Daejeon 34141, Republic of Korea.
Email: jungyong.lee@kaist.ac.kr

Keywords: Stretchable Electrodes, Liquid Metal Embedded Elastomer, Charge-Reverse Electro Writing

Prosthetic technologies rely on wearable bioelectronic interfaces that translate muscle activity into reliable control signals. Electromyographic (EMG) electrodes are key to this process, but conventional designs often fail to balance comfort, stability, and durability. Liquid metal composites offer advantages in conductivity, stretchability, and biocompatibility, yet achieving consistent and reproducible fabrication remains a challenge.

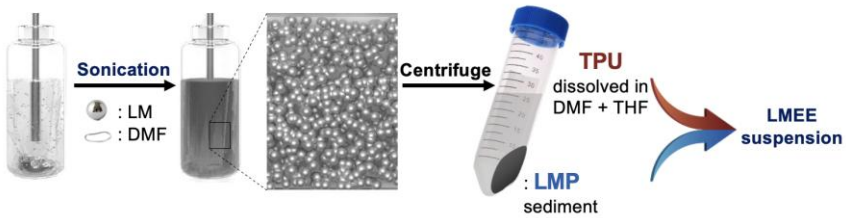


Fig. 1. Fabrication of LMEE suspension via sonication, centrifugation, and TPU blending. [References]

This research advances the fabrication of liquid metal–embedded elastomer (LMEE) meshes using the Charge–Reverse Electro Writing (CREW) technique. Initial trials produced poorly defined meshes with yields near 10%. Through systematic optimization, printing reliability was transformed, raising success rates above 90% and enabling the reproducible fabrication of fine, skin-like structures.

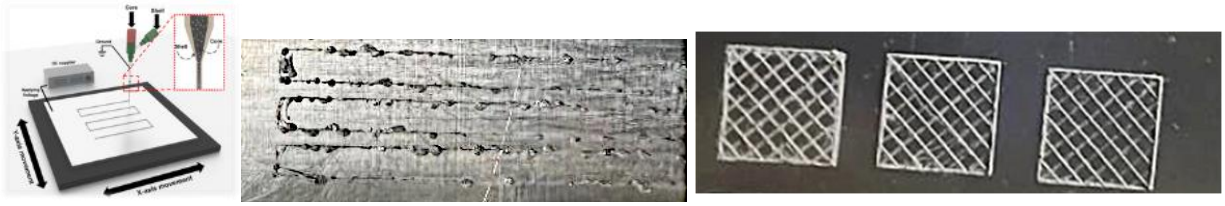


Fig. 2. (a) CREW setup schematic. (b) Initial print with droplet formation (~10% yield). (c) Optimized print with well-defined meshes (>90% yield).

Quantitative analysis identified a critical conductivity threshold of ~1 μS/cm: above this value, discharge events destabilized jetting, while below it, deposition remained stable. This insight, tied to LMNP:TPU ratios, provides a practical design rule for ink formulation. Electromechanical tests further confirmed robustness, with meshes exhibiting a low gauge factor (0.098) and maintaining high signal-to-noise ratios under strains up to 300%. Although direct EMG signal acquisition was beyond the present scope, this work establishes a reproducible foundation for next-generation prosthetic control systems using CREW-printed LMEE electrodes.

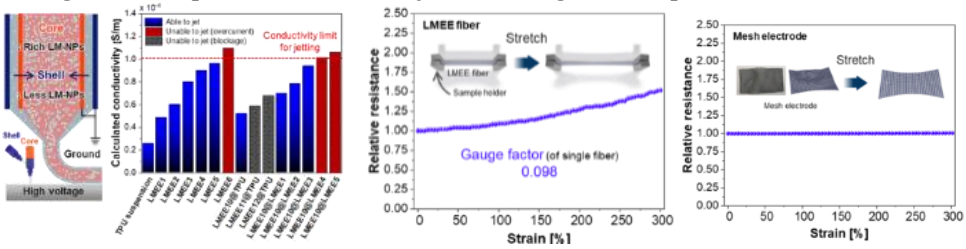


Fig. 3. (a) Conductivity threshold (b) LMEE fiber with low gauge factor. (c) Resistance stability up to 300% strain.

[References]

(1) X. Chen, C. C. L. Wang, *Addit. Manuf*., **2022**, 49, 102470.

(2) D. Mistry, C. M. Yakacki, *Nat. Commun*., **2021**, 12, 6677.

(3) S. Puthanveetil, H. Le Ferrand, Compos. *Sci. Technol*., **2022**, 217, 109097.

(4) A. Ahmadianyazdi, A. Folch, *Lab Chip*., **2023**, 23, 4019-4032.

[Poster 01-47]

Photocatalytic hydrogen generation of Simplified Y6-Derivatives

Min Gyu Kang[a,#], Han Young Woo[a,*]
[a]Department of Chemistry, Korea University, Seoul 136-713, Republic of Korea
Email: hywoo@korea.ac.kr

Keywords: Organic photocatalyst, Hydrogen, Photocatalytic nanoparticle

Organic photocatalysts offer great potential for green hydrogen production and sustainable energy generation due to their tunable chemical structures, enabling control over optical and electronic properties[1]. Molecular alignment significantly impacts charge transport and extraction, directly influencing hydrogen evolution efficiency, making its control crucial for performance optimization[2]. In this study, we synthesized YHD-2F by removing the undecyl chain from Y6, simplifying synthesis and enhancing molecular alignment[3]. We systematically analyzed their photocatalytic nanoparticles, revealing significantly higher hydrogen evolution rates (HER) than Y6, especially YHD-2F achieving over seven times the HER of Y6.

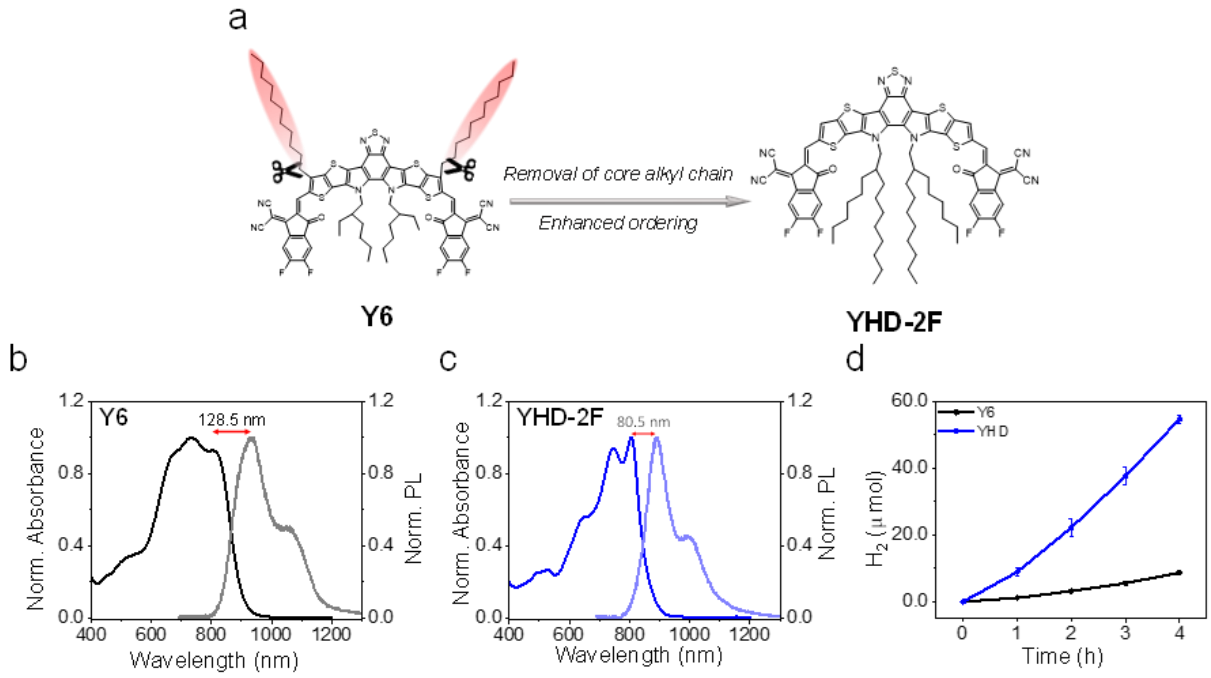


Fig. 1. (a) Molecular structures of Y6 and YHD-2F, (b) nanoparticle uv-vis spectra (dark color) and photoluminescence spectra (light color) of Y6, (b) nanoparticle uv-vis spectra (dark color) and photoluminescence spectra (light color) of YHD-2F, (d) Absolute amounts of H_2 generated at the optimized NP concentrations in a 0.2 M AA solution with 10 wt% Pt co-catalyst under AM 1.5G irradiation. (5.2 μg mL^{-1} for Y6, and 10.4 μg mL^{-1} for YHD-2F NPs.)

[Poster 01-48]

Conjugated Oligoelectrolyte-Driven Self-Assembled Monolayer for Bidirectional Interfacial Engineering in Sn–Pb Perovskite Solar Cells

Jong Bin Park[a,#], Jina Roe[b], Dong Gyu Lee[c], Tae Kyung Lee[c,*], Jin Young Kim[b,*], Han Young Woo[a,*]
[a] Department of Chemistry, Korea University, Seoul 02841, Republic of Korea.
[b] School of Energy and Chemical Engineering, Ulsan National Institute of Science and Technology (UNIST), Ulsan 44919, Republic of Korea.
[c] Department of Materials Engineering and Convergence Technology, Gyeongsang National University (GNU), 501 Jinju-daero, Jinju 52828, Republic of Korea.
Email: hywoo@korea.ac.kr

Keywords: conjugated oligoelectrolyte, self-assembled monolayer, Sn–Pb perovskite solar cells, interlayer, interfacial passivation**.**

Tin-lead (Sn–Pb) mixed perovskites exhibit ideal bandgaps (1.21–1.25 eV) for high-efficiency single-junction and tandem solar cells, yet they suffer from interfacial instability arising from Sn vacancies, Sn oxidation, and poor film morphology. While self-assembled monolayers (SAMs) have emerged as promising hole-selective interlayers,[1] conventional monophosphonate-based SAMs show weak interfacial binding and poor wettability, challenges that become more pronounced in scalable Sn–Pb perovskite solar cells (PSCs). Herein, a rationally designed SAM, 6,6'-(2,7-bis(9-(4-phosphonobutyl)-9H-carbazol-2-yl)-9H-fluorene-9,9-diyl)bis(N,N,N-trimethylhexan-1-ammonium bromide) (4PACz-TMABr), is developed, based on conjugated oligoelectrolytes featuring both phosphonic acid groups and ionic moieties. The dual phosphonic acid groups significantly improve interfacial coverage on indium tin oxide, while the quaternary ammonium bromide ionic moieties effectively suppress interfacial perovskite defects and Sn^{2+} oxidation.[2] These dual interactions strongly promote the orderly alignment of the SAM and facilitate its function as a bidirectional interfacial linker. The formation of uniform, high-crystallinity Sn–Pb perovskite films is further supported by density functional theory calculations. Consequently, 4PACz-TMABr-based Sn–Pb PSCs achieve a champion power conversion efficiency of 22.67% in small-area devices and 17.61% in 1 cm^2 devices, along with markedly improved thermal stability. This work highlights a strategic molecular approach to SAM design, offering a pathway toward scalable, stable, and efficient Sn–Pb perovskite PSCs.

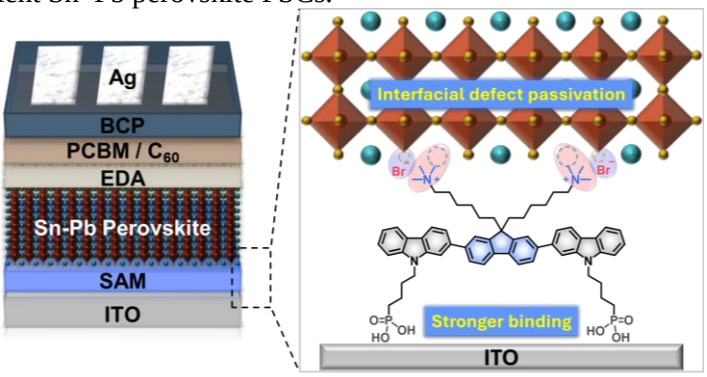


Fig. 1. Sn–Pb Perovskite Solar Cells Incorporating a Conjugated Oligoelectrolyte Self-Assembled Monolayer (SAM).

[References]

(1) Liu, M.; Bi, L.; Jiang, W.; Zeng, Z.; Tsang, S.-W.; Lin, F. R.; Jen, A. K.-Y. *Adv. Mater.* **2023**, *35*, 2304415.

(2) Pitaro, M.; Alonso, J. E. S.; Di Mario, L.; Romero, D. G.; Tran, K.; Kardula, J.; Zaharia, T.; Johansson, M. B.; Johansson, E. M. J.; Chiechi, R. C.; et al. *Adv. Funct. Mater.* **2024**, *34*, 2306571.

[Poster 01-49]

Tuning Crystallization of Industry Compatible Evaporation-Solution Method Wide Bandgap Perovskite for Perovskite/Silicon Tandem Solar Cells on Commercial Silicon Bottom Cells

Yu-Ting Chen[a,b,#], Jin-Yu Lin[c], Chih-Wei Chu[b,d], Tzung-Fang Guo[a,b,e,*]
[a] Program on Key Materials, Academy of Innovative Semiconductor and Sustainable Manufacturing, National Cheng Kung University, 701, Tainan, Taiwan, ROC
[b] Research Center for Critical Issues (RCCI), Academia Sinica, 711, Tainan, Taiwan, ROC
[c] Institute of Photonic System, College of Photonics, National Yang Ming Chiao Tung University, 711, Tainan, Taiwan, ROC
[d] Research Center for Applied Sciences (RCAS), Academia Sinica, 115, Taipei, Taiwan, ROC
[e] Department of Photonics, National Cheng Kung University, 701, Tainan, Taiwan, ROC
Email: guotf@mail.ncku.edu.tw

Keywords: hybrid two-step perovskite deposition, vacuum thermal evaporation, perovskite solar cells, perovskite/silicon tandem solar cells

Nowadays, monolithic perovskite/silicon tandem solar cells have attracted significant attention due to their further enhancement of the certified power conversion efficiency (PCE) of single-junction photovoltaics (PV) which has approached the Shockley-Queisser (SQ) theoretical limit. However, most of the reported high-efficiency tandem devices utilize planar silicon wafers with polished front surfaces[1], rather than the textured silicon wafers commonly used in the commercial silicon PV industry. Although standard solution-processing techniques can be readily applied to deposit high-quality, pinhole-free perovskite films on planar silicon sub-cells for tandem configurations, such approaches are typically costly and unsuitable for large-area or industrial-scale applications.

To address this, we employed a hybrid two-step method combining thermal evaporation and solution processing (referred to as the ES method) to fabricate wide-bandgap perovskite films. This method offers superior substrate conformality, making it more compatible with textured surfaces, and is scalable for large-area deposition while remaining compatible with industrial fabrication processes[2]. A key challenge of the ES method lies in precisely controlling the reaction kinetics to ensure the formation of uniform, high-quality perovskite films. We regulate the perovskite crystallization process, reaching open-circuit voltage (V_{OC}) of 1.80 V, short-circuit current density (J_{SC}) of 19.89 mA/cm^2, and a fill factor (FF) of 74.13%, PCE of 26.48% for the perovskite/silicon tandem solar cell on commercial Czochralski (CZ) silicon bottom cells.

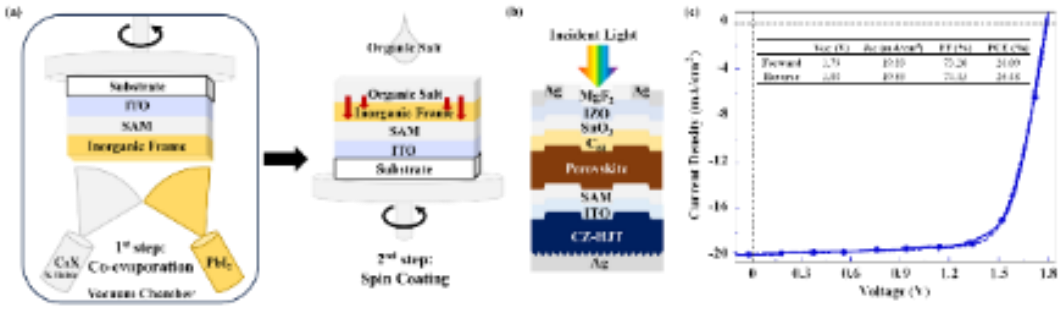


Fig. 1. (a) Schematic of the ES method. (b) Schematic of perovskite/silicon tandem device structure. (c) Photovoltaic performance of perovskite/silicon tandem device.

[References]

(1) S. Mariotti, E. Köhnen, F. Scheler, K. Sveinbjörnsson, L. Zimmermann, M. Piot, F. Yang, B. Li, J. Warby, A. Musiienko, D. Menzel, F. Lang, S. Keßler, I. Levine, D. Mantione, A. Al-Ashouri, M. S. Härtel, K. Xu, A. Cruz, J. Kurpiers, P. Wagner, H. Köbler, J. Li, A. Magomedov, D. Mecerreyes, E. Unger, A. Abate, M. Stolterfoht, B. Stannowski, R. Schlatmann, L. Korte, S. Albrecht, *Science*, **2023**, 381, 63-69.

(2) X. Zheng, W. Kong, J. Wen, J. Hong, H. Luo, R. Xia, Z. Huang, X. Luo, Z. Liu, H. Li, H. Sun, Y. Wang, C. Liu, P. Wu, H. Gao, M. Li, A. D. Bui, Y. Mo, X. Zhang, G. Yang, Y. Chen, Z. Feng, H. T. Nguyen, R. Lin, L. Li, J. Gao, H. Tan, *Nat. Commun.*, **2024**, 15, 4907.

[Poster 01-50]

Halogen Substitution in Non-Fullerene Acceptors for High-Performance Near-Infrared Organic Photodetectors and Semi-Transparent Solar Cells

Ji Yeon Son[a,#], Du Hyeon Ryu[b], Hyeong Ju Eun[a], Ah Young Lee[a], Jong-Woon Ha[c], Jong H. Kim[a,*]
[a]Department of Molecular Science Technology, Ajou University, Suwon 16499, Republic of Korea
[b]Photoenergy Research Center, Korea Research Institute of Chemical Technology (KRICT), Daejeon 34114, Republic of Korea
[c]Department of Materials Engineering and Convergence Technology, Gyeongsang National University, Jinju 52828, Republic of Korea
Email: jonghkim@ajou.ac.kr

Keywords: Near-infrared, Organic photodetectors, Semi-transparent organic solar cells, Non-fullerene acceptors, Halogen substitution

Near-infrared (NIR) absorbing organic semiconductors are essential for next-generation optoelectronic devices, including organic photodetectors (OPDs) and semi-transparent organic solar cells (ST-OSCs).[1] Here, we report two fluoro-substituted thienothiophene (FTT)-based non-fullerene acceptors (NFAs), FFT-ICF and FTT-ICCl, designed within an A−D−A'−D−A framework. Two NFAs possess indanone-malononitrile (IC) end groups substituted with fluorine (FFT-ICF) and chlorine (FFT-ICCl), resulting in optical bandgaps of 1.24 and 1.22 eV, respectively. Both exhibit strong NIR absorption while maintaining intrinsic optical transparency in visible range. Compared with PTB7-Th:FTT-ICCl blends, PTB7-Th:FTT-ICF blends formed well-defined fibrillar networks that suppressed energetic disorder and facilitated efficient charge transport. Consequently, PTB7-Th:FTT-ICF-based OPDs achieved an exceptionally low dark current density of 4.59×10^{-9} A cm^{-2}, a high responsivity of 0.38 A W^{-1}, and a specific detectivity (D_{shot}^{*}) of 1.00×10^{13} Jones at 950 nm under −0.5 V, while retaining excellent uniformity (< 10 %) across a 4 × 4 pixel OPD array. In addition, PTB7-Th:FTT-ICF-based ST-OSCs achieved a power conversion efficiency of 9.1 %, an average visible transmittance of 25.1 %, and a light utilization efficiency of 2.28 %. These findings demonstrate that halogen substitution at the end groups offers an effective strategy to control molecular organization and enhance the performance of NIR OPDs and ST-OSCs.

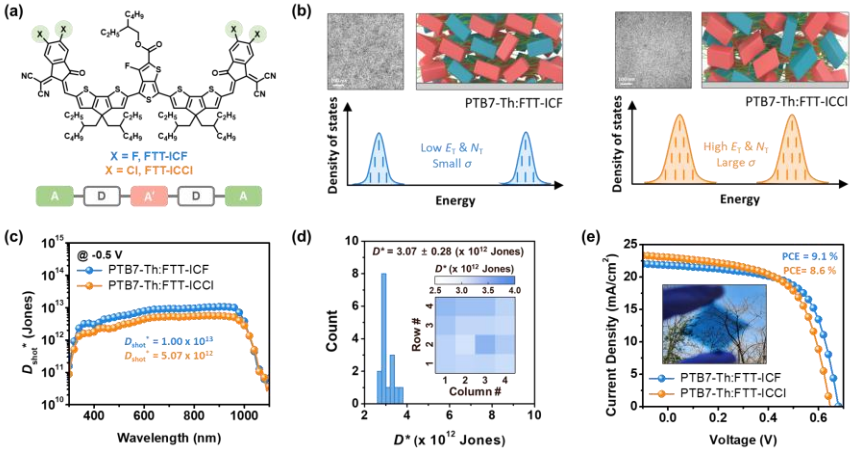


Fig. 1. (a) Chemical structures of FTT-ICF and FTT-ICCl. (b) TEM images and energetic disorder comparison of PTB7-Th:FTT-ICF and PTB7-Th:FTT-ICCl films. (c) D_{shot}^{*} spectra measured under −0.5 V. (d) Distribution histograms and spatial mapping of D_{shot}^{*} values for a 4 × 4 pixel OPD array. (e) *J*−*V* curves and a device photograph of ST-OSCs.

[References]

(1) Meng, D.; Zheng, R.; Zhao, Y.; Zhang, E.; Dou, L.; Yang, Y. *Adv. Mater.* **2022**, *34*, 2107330

[Poster 01-51]

Improving Stability of Blue Pt(II) Complex for Long Operational Lifetime Blue PhOLED

Young Hun Jung[a], and Jang Hyuk Kwon[a,#,*]
[a]Organic Optoelectronic Device Lab (OODL), Dept. of Inform. Display, Kyung Hee University,
26, Kyungheedae-ro, Dongdaemun-gu, Seoul 02447, Republic of Korea
Email: jhkwon@khu.ac.kr

Keywords: OLED, Blue, Pt (II) complex, phosphorescent dopant, long lifetime

In the display Industry, there has been tremendous research on blue phosphorescent (Ph) dopant to replace blue fluorescent dopant, which cause the low power efficiency of organic light-emitting diodes (OLEDs) panel. However, blue Ph dopants have not yet been commercialized due to their insufficient operational lifetime compared to red and green Ph dopant. Therefore, blue Ph dopant with high efficiency and stability have been investigated in many research groups.

Recently, Y. H. Jung developed PtON-tb-DTB by modifying t-butyl group on PtON-TBBI, which shows high stability in the device[1]. In their research, it was clarified that ^{3}MC state formation through triplet-triplet annihilation (TTA) can be attributed to degradation. To improve the stability, following molecular features were required: (1) The reduction of metal-metal-to-ligand charge transfer (MMLCT) formation suppress the exciton diffusion causing the TTA process, (2) The root mean squared distance (RMSD) between T_1 and ^{3}MC state should be small, which induces degradation of molecule through relaxation process, and (3) the small activation energy from ^{3}MC to T_1 ($E_a^{^3MC\rightarrow T_1}$) is required to reduce ^{3}MC exciton population.

Based on previous research, we designed PtON-2,6-TPI, which is presented on the Fig. 1.(a), by substituting terphenyl group instead of 3,5-di-tert-butyl group on PtON-TBBI to suppress MMLCT formation through sterically shielded structure. Through DFT simulation, it is clarified that PtON-2,6-TPI has smaller RMSD and lower $E_a^{^3MC\rightarrow T_1}$ than PtON-TBBI. In addition, PtON-2,6-TPI has deeper HOMO, which can cause the hole de-trap effects. The OLEDs were fabricated using PtON-TBBI and PtON-2,6-TPI. The PtON-TBBI used OLED shows LT90 of 63 h at initial luminescence of 1,000 nit and CIE_y of 0.20. however, PtON-2,6-TPI used OLED shows 2 times longer device lifetime (LT90~120h) with deeper blue color (CIE_y~0.15) as shown on Fig. 1. (b). The PtON-2,6-TPI used device shows reduced shoulder peak due to shifted recombination zone to ETL side induced by hole de-trap effect. Also, longer device lifetime was affected from hole de-trap effect by reducing polaron induced quenching and broadening recombination zone, in addition to improved photo-stability. The detailed information for material design and device analysis will be discussed at the conference.

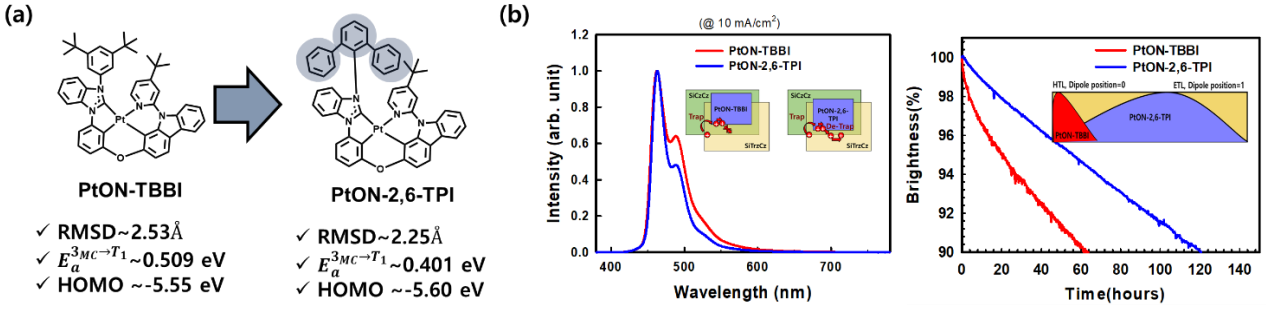


Fig. 1. (a) Molecular structure, RMSD value between T_1 and ^{3}MC, $E_a^{^3MC\rightarrow T_1}$ value, HOMO for PtON-TBBI and PtON-2,6-TPI. (b) Electro-Luminescence spectra at J=10mA cm^{-2}, and device lifetime at initial luminescence of 1,000 nit.

[References]

(1) Y. H. Jung, G. S. Lee, S. Muruganantham, H. R. Kim, J. H. Oh, J. H. Ham, S. B. Yadav, J. H. Lee, M. Y. Chae, Y. H. Kim, and J. H. Kwon, *Nat. Commun*. **2024**, *15*, 1, 2977

[Poster 01-52]

Synergistic Indolocarbazole Stitching and Peripheral Acceptor Engineering Enable Narrowband Green MR-TADF Emitters For High-Efficiency, Long-Lifetime OLEDs

Hai Truyen Dang [a,#], Thuy Truong Thi [a], Nikita Abitkar[a], Subramanian Muruganantham[a], Aradhya Rajput[a], Paramasivam Palanisamy[a], Myungsun Sim[b], Jiheon Kim[b], Mi Young Chae[a], Jang Hyuk Kwon[a,*]
[a]Organic Optoelectronic Device Lab (OODL), Department of Information Display, KyungHee University, 26 Kyungheedae ro, Dongdaemun-gu, Seoul 02447, Republic of Korea.
[b]Samsung Advanced Institute of Technology, 130 Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Republic of Korea
Email: jhkwon@khu.ac.kr

Keywords: Indolocarbazole, narrow FWHM, green MR TADF, high EQE, long lifetime**.**

Achieving narrowband green emission with high efficiency and long-term stability is critical for realizing BT.2020-compliant OLED displays. Herein, we present a series of indolocarbazole–boron–nitrogen MR-TADF emitters (KGT-25-4, KGT-25-7, KGT-25-8, KGT-25-9) that integrate molecular rigidification with peripheral acceptor engineering. All emitters exhibit intense green photoluminescence (λ_{em} = 522–540 nm) with narrow bandwidths (FWHM = 21–24 nm), high photoluminescence quantum yields (>90 %), and small singlet–triplet energy gaps (ΔE_{ST} = 0.23–0.26 eV). When incorporated into phosphorescent-sensitized fluorescence (PSF) OLEDs with an exciplex co-host, the KGT-25-7 achieves efficient Förster energy transfer. The resulting device attains a maximum EQE of 28.9 %, narrowband emission (540 nm, FWHM = 30 nm), excellent roll-off suppression (26.2 % at 5000 cd m^{-2}), and outstanding stability (LT_{97} = 143 h at 5000 cd m^{-2}). Bond dissociation energy analysis further confirms the enhanced cationic framework stability of KGT-25-7, correlating with its prolonged operational lifetime. This work establishes a synergistic molecular and device design principle for developing efficient, stable, and color-pure green MR-TADF OLEDs.

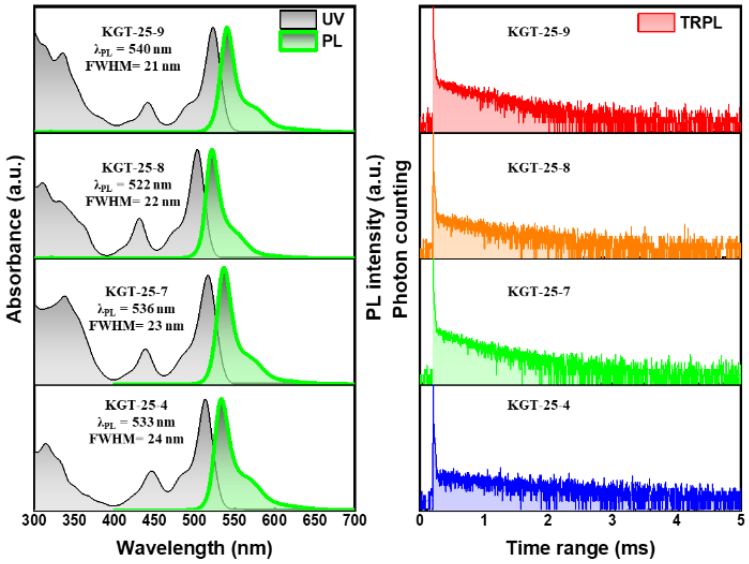


Fig. 1. a) UV–Vis absorption spectra and Room temperature PL spectra (at 300 K) measured in toluene at 10^{-5} M concentration and b) Transient PL decay curve measured in mCBP-CN host matrix.

[Poster 01-53]

Machine Learning- Driven Design of Sterically Protected High-Triplet Exciplex Hosts for Efficient Green OLEDs

Truong Thi Thuy[a,#], Sunggi An[b], Jang Huyk Kwon[a,*], Yousung Jung[b,*]
[a]Department of Information Display, Kyung Hee University, Dongdaemoon-gu, Seoul 130-701, South Korea
[b]Department of Chemical and Biomolecular Engineering, Korea Advanced Institute of Science and Technology (KAIST), 291, Daehak-ro, Yuseong-gu, Daejeon 34141 South Korea.
Email: jhkwon@khu.ac.kr; yousung.Jung@gnu.ac.kr

Keywords: machine learning, high triplet exciplex, intermolecular interaction suppression, back energy transfer**.**

Exciton management in phosphorescence-sensitized fluorescent organic light-emitting diodes (PSF-OLED) is constrained by back energy transfer and triplet quenching within the exciplex host. This work presents a machine-learning-guided molecular-design framework that combines electronic-structure prediction, bond-dissociation energy (BDE) assessment, and exciton-dynamic analysis to identify high-triplet exciplex hosts for green PSF-OLEDs. An iterative generation process was utilized to identify potential n-type host molecules, subsequently screened for triplet energy (T_1 > 2.8 eV), deep LUMO alignment, low reorganization energy (< 0.4 eV), and high anionic bond dissociation energies (BDEs) to guarantee exciton confinement and device stability. Two silane-functionalized hosts, DPSiTrz and DBiPSiTrz, were identified as the most suitable candidates. The bulky phenyl-silane moiety effectively inhibits intermolecular aggregation and triplet–triplet annihilation, while preserving the donor–acceptor coupling necessary for exciplex formation. Excited-state simulations and photophysical analyses indicate that the exciplexes BPP-BCZ:DPSiTrz and BPP-BCZ:DBiPSiTrz exhibit high triplet energies, minimal ΔE_{ST}, and decreased non-radiative triplet decay rates (~10^4 s^{-1}). The properties of the phosphorescent sensitizer $Ir(ppy)_2(acac)$ inhibit BET and facilitate efficient Dexter energy transfer (DET) to the terminal MR-TADF emitter (tCzphB-Fl). Consequently, the utilization of excitons is markedly improved via Förster and Dexter transfer mechanisms.

Device-level studies demonstrate that exciplex-based PSF-OLEDs utilizing the proposed hosts attain near-theoretical external quantum efficiencies (EQE) of 39.4% and 39.1%, which correlate with high photoluminescence quantum yields (97%) and a horizontal dipole orientation of approximately 90%. These devices demonstrate minimal efficiency roll-off (L_{90} > 100,000 cd m^{-2}) and possess acceptable operational lifetimes (LT_{95} = 134.4 h at 5000 cd m^{-2}), surpassing traditional exciplex and phosphorescent OLEDs.

Our work illustrates the connection between machine-learning-assisted molecular design and exciton-dynamics modeling, establishing a direct relationship between chemical descriptors (T_1, BDE, ROE) and device-level performance. The combination of high-triplet exciplex hosts with phosphorescent-assisted energy-transfer methods creates a broadly applicable approach for developing high-brightness, long-lifetime OLEDs suitable for next-generation display and lighting technologies.

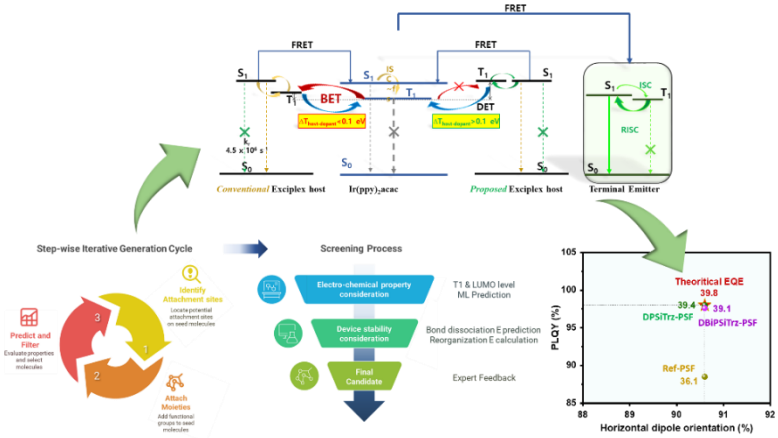


Fig. 1. ML-guided exciplex host design and exciton dynamics in PSF-OLEDs.

[Poster 01-54]

Exciplex Host Engineering for High Efficiency and Operational Stability of Green PSF Technology

Odugu Pavan Kumar[a,#], Jang Hyuk Kwon[a,*]
[a]Organic Optoelectronic Device Lab. (OODL), Department of Information Display, Kyung Hee University, 26, Kyungheedae-ro, Dongdaemun-gu, Seoul 02447, Korea.
Email: jhkwon@khu.ac.kr

Keywords: Exciplex Host, High Efficiency, PSF OLED, Pure Green, Long lifetime

Recently, both academic and industrial experts have concentrated on the progress of high-efficiency and stable green organic light-emitting diodes (OLEDs) through the application of phosphorescence sensitized fluorescence (PSF) technology. One strategy for enhancing the efficiency of PSF OLED is the implementation of the dual-channel Förster resonance energy transfer (FRET) process. This involves the direct energy transfer from the host to the final dopant (FD) as well as from the phosphorescence sensitizer (PS) to the FD. The earlier mentioned results can only be realized through the application of thermally activated delayed fluorescence (TADF) or exciplex host systems. In this regard, we designed and synthesized three novel electron-transporting (ET) host materials DTTrzDF-1, DTTrzDF-2, and DTTrzDFph-3 featuring dibenzothiophene, dibenzofuran, and triazine-based cores to develop an efficient exciplex host system for green phosphorescent sensitized fluorescence (PSF) OLEDs. Structural modifications, including dibenzofuran and phenyl substitutions, significantly influenced the photophysical and electrochemical properties as well as bond dissociation energy (BDE) values. To optimize the exciplex host system, 9-([1,1′-biphenyl]-4-yl)-9′-phenyl-9H,9′H-3,3′-bicarbazole (BPP-BCz) was employed as the p-type material. The resulting PSF OLEDs by incorporating a well-known green MR-TADF emitter (tCzphB-Fl), fabricated using DTTrzDF-1 and DTTrzDFph-3, achieved high maximum external quantum efficiencies (EQE_{max}) of 34.1% and 36.2%, respectively, with minimal efficiency roll-off of 4.1% and 7.7% at 5000 cd/m^2. The improved efficiencies of the PSF OLEDs can be attributed to the dual channel energy transfer, enhanced by the supplementary FRET from the exciplex host to the FD. Furthermore, these devices exhibited extended operational lifetimes (LT_{95}) of 3628 h and 6353 h at an initial luminescence of 1000cd/m^2. The prolonged lifespan of the BPP-BCz: DTTrzDFph-3 is attributed to the intrinsic stability of the n-type host material, which reduces device degradation.

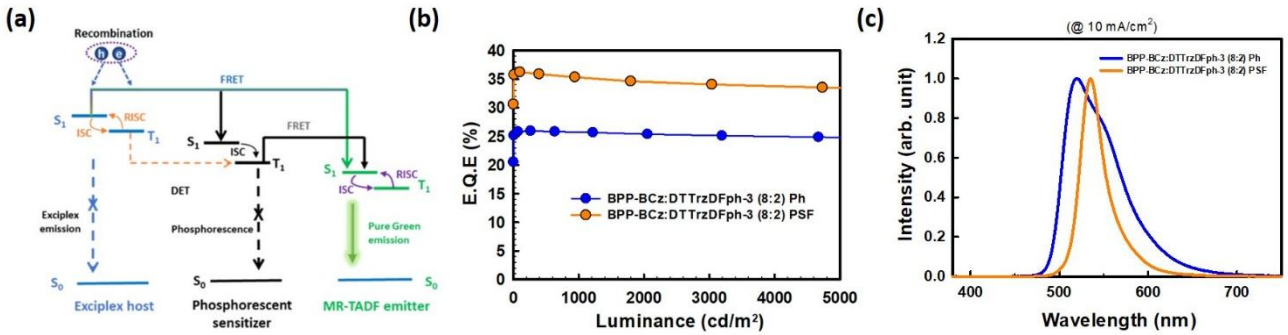


Fig 1. (a) Emission mechanism of PSF OLED, (b) EQE vs Luminescence and (c) EL Emission spectrum.

[Poster 01-55]

Stable n-Doped Electron Transport Materials for High-Efficiency and Long-Lifetime Tandem Blue OLEDs

Subramanian Muruganantham[a,#] Jun hyeog Oh[a], and Jang Hyuk Kwon[a,*]
[a]Organic Optoelectronic Device Lab (OODL), Department of Information Display
Kyung Hee University 26, Kyungheedae-ro, Dongdaemun-gu, Seoul 02447, Republic of Korea
Email: jhkwon@khu.ac.kr

Keywords: Blue tandem OLEDs, Charge generation units, Electron transport materials, n-Doping, long lifetime

Tandem blue organic light-emitting diodes (OLEDs) are a promising route to meet the stringent demands for high efficiency and long operational lifetime in next-generation displays. However, their performance is still constrained by inefficient charge generation, poor electron injection, and instability associated with reactive n-dopants.[1-3] Here, we introduce two isomeric diphenanthroline based electron-transport materials, **PA-pPDPhen** and **PA-mPDPhen**, which feature a rigid phenanthrene core connected to nitrogen-rich phenanthroline units through *para*- and *meta*-phenyl linkers. These materials exhibit strong electron affinity, high thermal and morphological stability, and efficient lithium complexation facilitated by their nucleophilic character and favourable coordination enthalpy. While employed in n-doped charge generation units, both materials significantly lower the electron-injection barrier and suppress lithium-ion migration. Laterally integrated into tandem blue OLEDs, they achieve external quantum efficiencies exceeding 20.8%, with operational lifetimes (LT_{95} at 1000 cd/m²) of 280 h and 218 h, respectively surpassing the benchmark ETM BPhen (165 h). These results highlight a molecular design strategy for stable, n-dopant-compatible charge generation materials, advancing the development of efficient and durable tandem OLED architectures.

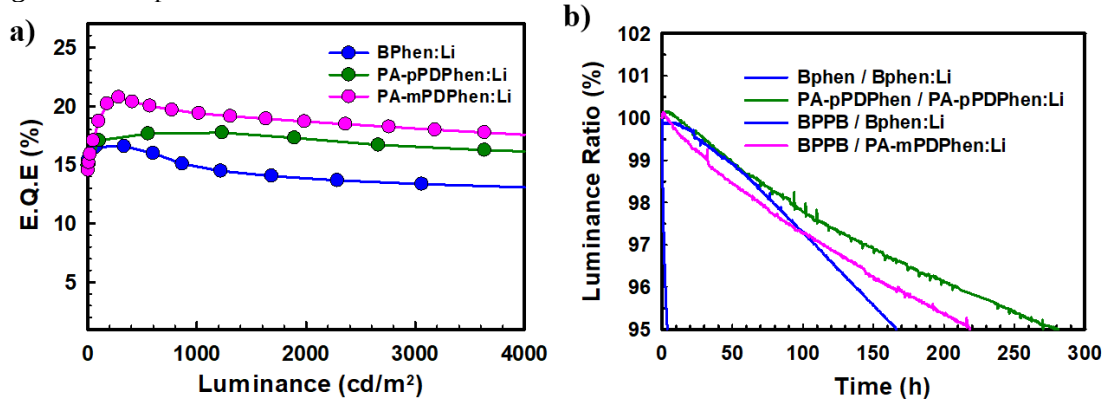


Fig. 1. (a) EQE max vs Luminance and (b) Device lifetime at 1000 cd/m².

[References]

(1) Kim G. W, Son Y. H, Yang H. I, Park J. H, Ko I. J, Lampande R, Sakong J, Maeng M. J, Hong J. A, Lee J. Y, Park Y, Kwon J. H., *Chem. Mater*, **2017,** *29*, 8299.

(2) Udagawa K, Sasabe H, Cai C, Kido J, *Adv. Mater*, **2014**, *26*, 5062.

(3) Z. Liu, X. Li, Y. Lu, C. Zhang, Y. Zhang, T. Huang, D. Zhang, L. Duan, *Nat.Commun*., **2022**, *13*, 1215.

[Poster 01-56]

Metallic-interlayer assisted liquid metal electrode for high performance intrinsically stretchable organic solar cells

Seungbok Lee[a,#], Jung-Yong Lee[a,*]
[a] School of Electrical Engineering, Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea
Email: jungyong.lee@kaist.ac.kr

Keywords: stretchable electrode, intrinsically stretchable organic solar cells, liquid metal, metallic-interlayer, thermal evaporation

Stretchable electronics require independent, deformable power sources. Intrinsically stretchable organic solar cells (IS-OSCs) are promising due to their lightweight and flexibility, but all layers—including the top electrode—must be stretchable. The top electrode is critical for charge extraction and mechanical durability, yet stretchable top electrodes remain underdeveloped. Liquid metals like eutectic gallium–indium (EGaIn) offer high conductivity (3.4×10^6 S/m) and negligible modulus, making them attractive candidates. Among fabrication methods, physical vapor deposition (PVD) is favorable for IS-OSCs due to its scalability and precision. However, prior PVD-based electrodes (InOG) suffered from high resistance from native oxides, while spray-deposited electrodes maintained conductivity but faced issues with oxide barriers and poor interlayer adhesion[1].

Here, we introduce a thermally evaporated stretchable electrode with a metallic-interlayer (indium/metallic-interlayer/gallium, InMiG). The interlayer reduces contact resistance and improves gallium wettability, enabling a uniform conductive film. In this structure, nanoclusters of indium dissipate strain, the interlayer maintains conductivity, and gallium forms a continuous envelope. Consequently, InMiG electrodes achieve high conductivity (4.1×10^6 S/m) and excellent stretchability, with only a 1.9-fold resistance increase at 100% strain. IS-OSCs using InMiG exhibited a PCE of 14.6% and strong mechanical resilience (ε_{PCE70} = 63%), outperforming spray-deposited counterparts (PCE = 11.7%, ε_{PCE70} = 42%). The metallic interlayer improved charge extraction and interfacial recombination, enhancing J_{SC} (from 21.32 to 23.52 mA/cm²) and *FF* (from 0.65 to 0.74), while stronger adhesion minimized voltage loss under strain, advancing the intrinsic stretchability of the device.

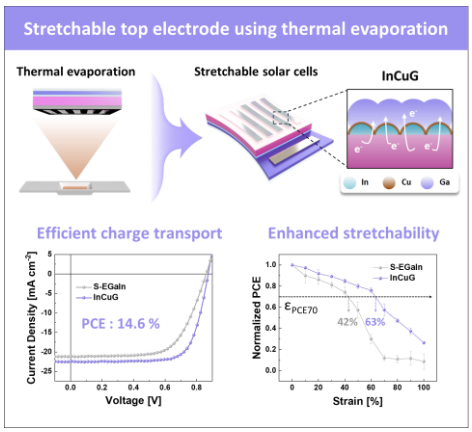


Fig. 1. Schematic of liquid metal formation using thermal evaporation and characteristics of solar cells

[References]

(1) Seungseok Han, Kyungmin Kim, Sang Yeon Lee, Seongjun Moon, Jung-Yong-Lee, *Adv.Mater.*, **2023**, 35, 2210112.

[Poster 01-57]

Suppressing Hole Accumulation through Sub-Nanometer Dipole Interfaces in Hybrid Perovskite/Organic Solar Cells for Boosting Near-Infrared Photon Harvesting

1st Min Seok Kim[a,#], 2nd Min-Ho Lee[a], 3rd Jung-Yong Lee[a,*]
[a] School of Electrical Engineering (EE), Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Republic of Korea
E-mail: jungyong.lee@kaist.ac.kr

Keywords: perovskite solar cell, hybrid perovskite/organic structure, hole accumulation, dipole layer, energy barrier

Metal halide perovskites (ABX_3) have emerged as promising semiconducting materials for optoelectronic devices, attributed to their exceptional photovoltaic characteristics. In the past decade, advancements in perovskite crystallinity, passivation, and carrier transport have enabled perovskite solar cells (PSCs) to approach the theoretical power conversion efficiencies (PCE) limit, achieving up to 27%. Although Pb-based PSCs demonstrate high performance, their absorption spectrum, which falls below 850 nm, limits the utilization of radiation in the near-infrared (NIR) region. To overcome this limitation, we introduced hybrid perovskite/organic solar cells (HSCs). HSCs employ an organic bulk-heterojunction (BHJ) layer serves as the charge-transport layer, enhancing photocurrent through near-infrared photon harvesting via complementary absorption, providing a moisture barrier owing to the intrinsic hydrophobicity of the organic donors/acceptors, and passivating perovskite defects through electron-rich functional groups. However, the relatively higher HOMO level of the donor versus the perovskite creates an energy barrier that hinders hole transport and forms a potential well at the perovskite/BHJ interface, inducing hole accumulation from both sides and reducing V_{OC} and fill factor (FF)[1].

To resolve this, we introduce sub-nanometer dipole interfacial layers (DILs) of small molecules (B3PyMPM) at the perovskite/BHJ interface (Figure 1a). B3PyMPM molecules possess permanent dipole moments that induce interfacial polarization and tune energy levels, with hydrogen bonding orienting the dipoles on the perovskite surface toward the cathode to facilitate hole transport. Without DILs, PM6 deposition induces a 0.18 eV vacuum-level downshift, whereas B3PyMPM yields a stronger interfacial dipole of 0.52 eV and reduces the perovskite barrier from 0.10 to 0.03 eV. Consequently, the control HSC attains 20.5% PCE with a J_{SC} gain of 3.1 mA cm^{-2} from NIR harvesting, whereas the DIL treated HSC device with B3PyMPM reaches 24.0% PCE driven by a 4.9 mA cm^{-2} J_{SC} increase and achieved 70% of NIR EQE, including improved V_{OC} and FF (Figure 1b-c).

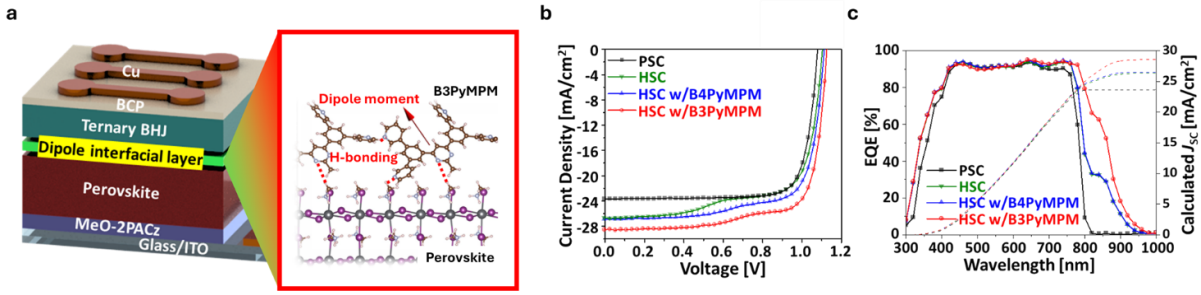


Fig. 1. a) Schematic representations of device architectures for interface-treated Hybrid Perovskite/Organic Solar Cells (HSC) and formation of dipole interfacial layer of B3PyMPM on the perovskite surface. b) Representative J-V characteristics and corresponding c) EQE spectra with calculated J_{SC} of perovskite solar cell (PSC) and HSC devices.

[References]

(1) Ting Wang, Yixin Dong, Jiahao Guo, Qiaohui Li, Zhitao Chang, Mingqian Chen, Rui Wang, and Yongsheng Liu, *Adv. Funct. Mater.* **2021**, *31*, 2107129

[Poster 01-58]

Improved Performance of Perovskite Quantum Dot Photodetectors through Halide Vacancy Suppression via Phosphine-Based Ligand Engineering

Byeongchan Park[a#] and *Kilwon Cho*[a*]
[a]Department of Chemical Engineering, Pohang University of Science and Technology, Pohang 37673, Republic of Korea
Email: kwcho@postech.ac.kr

Keywords: lattice-matched ligands, ligand engineering, perovskite quantum dots, photodetectors, trap passivation.

Perovskite quantum dot (QD) photodetectors have emerged as promising candidates for next-generation optoelectronic devices owing to their high absorption coefficients, tunable electronic structures, and facile solution processing. Despite these advantages, their operational stability under ambient conditions remains a major obstacle, particularly due to degradation induced by halide vacancies in $CsPbI_3$-based perovskites. Such vacancies generate shallow trap states that lower the photoluminescence quantum yield (PLQY) and deteriorate charge transport by promoting non-radiative recombination[1]. To mitigate these effects, we employed 1,3-bis(diphenylphosphino)propane (DPPP) as a surface passivation ligand. The lone pairs on phosphorus atoms form strong coordination bonds with undercoordinated Pb^{2+} ions, effectively healing halide vacancies. This ligand treatment enhances PLQY, stabilizes ion distribution, and significantly improves both efficiency and durability of QD photodiodes. Our findings highlight a practical pathway for advancing the performance and environmental robustness of perovskite-based optoelectronic systems.

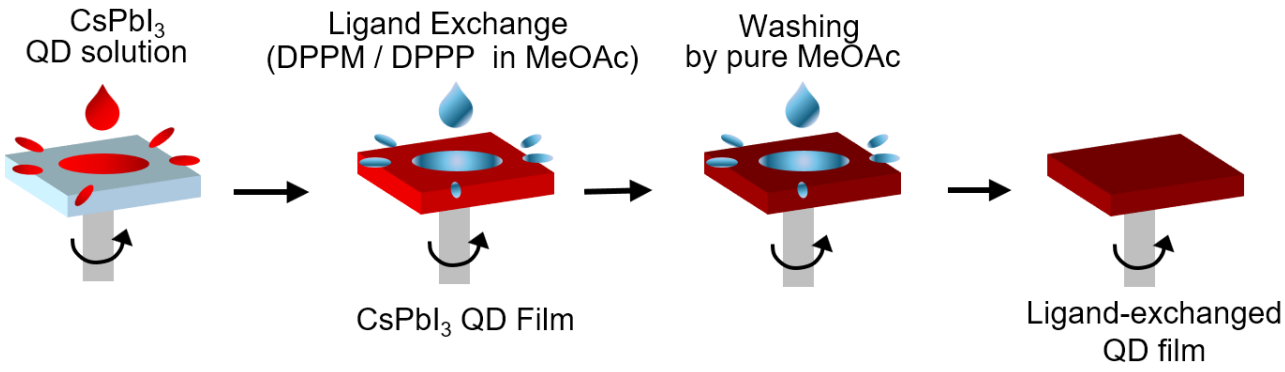


Fig. 1. Schematic illustration of the ligand exchange process in QD films using DPPM and DPPP ligands.

(1) J. Choi, J. Kim, M. Jeong, B. Park, S. Kim, J. Park, K. Cho, *Small* **2024**, 20, e2405598.

[Poster 01-59]

Impact of Fluorination on Exciton Dissociation and Interchain Polaron Formation in Push–Pull Conjugated Polymer Aggregates

Hyeokgu Yun[a,#], Dongki Lee[b] and Kilwon Cho[a,*]

[a] Dept. of Chemical Engineering, Pohang University of Science and Technology (POSTECH), 77, Cheongam-ro, Nam-gu, Pohang-si, Gyeongsangbuk-do, Republic of Korea (37673)
[b] Dept. of Nanotechnology and Advanced Materials Engineering, Sejong University, 28-1, Dongil-ro 50-gil, Gwangjin-gu, Seoul, Republic of Korea (05000)

Email: kwcho@postech.ac.kr

Keywords: Fluorination, Exciton Dissociation, Polaron Dynamics, Conjugated Polymers, Transient Absorption Spectroscopy

We investigated how fluorination and polymer chain length influence exciton dissociation dynamics in push–pull conjugated polymer (CP) aggregates using transient absorption spectroscopy. Aggregates of PBDB-T (Mw 40k and 100k) and PM6 (Mw 100k) exhibited distinct excitonic coupling behaviors, with PM6 showing markedly different interchain electronic interactions compared to PBDB-T.[1] The comparison of spectral responses under dual pump excitation conditions further revealed changes in exciton coupling patterns. Moreover, two distinct fluorination-induced effects were identified in PM6 aggregates, highlighting its altered charge separation characteristics. These results advance the understanding of exciton and polaron processes in conjugated polymer assemblies and offer valuable insights for optimizing bulk-heterojunction polymer solar cell systems.

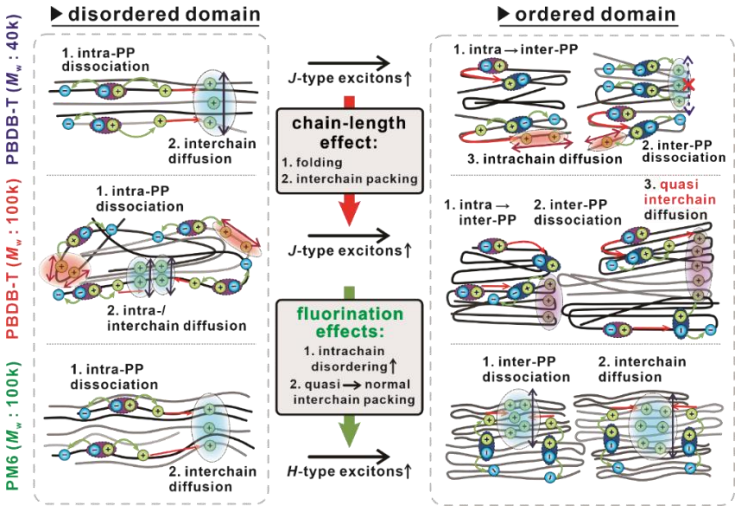


Fig. 1. Schematic illustration of the chain-length (inducing the folding structure and interchain packing) and fluorination effects (decreasing the intrachain rigidity and converting the quasi- to the normal interchain packing) on the photophysics within the push−pull CP aggregates (the exciton- dissociation mechanisms in the disordered and ordered domains); PP: polaron pair.

(1) Frank C. Spano, Carlos Silva, *Annu. Rev. Phys. Chem.*, **2014**.65:477-500

[Poster 02-1]

Low-temperature Photo-Crosslinkable, Highly Moisture-Resistant, and Flexible Encapsulant for Versatile Organic and Hybrid Optoelectronic Devices

Gyeong G. Jeon[a,#], Jihoon Kim[b], Dajeong Kim[c], Eon Ji Lee[d], Da seul Lee[e,f], Jongmin Choi[d], Seong Sik Shin[e,f], Bo Ram Lee[b], Nochang Park[c], and Jong H. Kim[a,*]

[a]Department of Molecular Science Technology, Ajou University, Suwon 16499, Republic of Korea

[b]School of Advanced Materials Science and Engineering, Sungkyunkwan University (SKKU), Suwon 16419, Republic of Korea

[c]Advanced Batteries Research Center, Korea Electronic Technology Institute (KETI), Seongnam 13509, Republic of Korea

[d]Department of Energy Science and Engineering, Daegu Gyeongbuk Institute of Science and Technology (DGIST), Daegu 42988, Republic of Korea

[e]Department of Nano Science and Technology, Sungkyunkwan University, Suwon, Republic of Korea

[f]SKKU Advanced Institute of Nanotechnology (SAINT) and Department of Nanoengineering, Sungkyunkwan University, Suwon 16419, Republic of Korea

Email: jonghkim@ajou.ac.kr

Keywords: Fluorine additives, Thin-film encapsulation, Flexible applications, Moisture stability, Optoelectronic devices

Next-generation optoelectronic devices, including photovoltaics, photodetectors, and light-emitting diodes, offer advantages such as lightweight, mechanical flexibility, and low-cost solution processability. However, their commercialization is limited by low ambient stability due to degradation by moisture.[1] To address this challenge, we develop a novel flexible hybrid thin-film encapsulation (HTFE) material, a fluorine-enhanced perhydropolysilazane incorporating hexafluoropropane trimer, F-HTFE, to improve hydrophobicity. The F-HTFE exhibits superior moisture resistance, achieving a water vapor transmission rate (WVTR) below 5×10^{-5} g m^{-2} day^{-1} with excellent optical transparency (over 90%) and scalability to large-area applications (up to 9 × 9 cm^2). When integrated into perovskite solar cells (PSCs), the F-HTFE retains 90% of its initial power conversion efficiency (PCE) after 1000 hours under 100% relative humidity (RH). Diverse optoelectronic devices, including quantum dot and organic solar cells, organic photodetectors, and organic light-emitting diodes, demonstrated enhanced moisture stability with the F-HTFE layer under high humidity conditions. As a practical demonstration, large-area flexible perovskite solar modules (f-PSMs) with F-HTFE maintain 95% of their initial performance after 1000 bending cycles and 89% of their initial PCE after 100 hours under 100% RH. These results highlight F-HTFE as a solution processable, scalable, transparent, and highly water-resistant encapsulant for next-generation flexible optoelectronic devices.

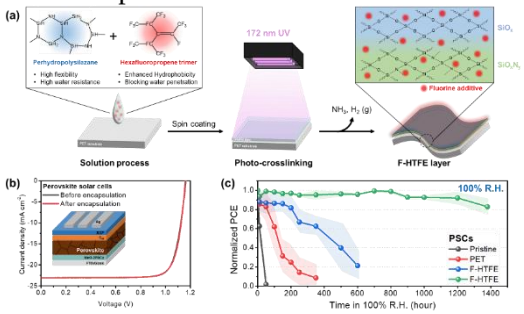


Fig. 1. (a) Fabrication of F-HTFE layers for superior moisture barrier. (b) *J-V* curves of perovskite solar cells (PSCs) before and after encapsulation. (c) The normalized PCE values of PSCs as a function of time in 100% R.H.

[References]

(1) Domanski, K.; Alharbi, E. A.; Hagfeldt, A.; Grätzel, M.; Tress, W. *Nat. Energy* **2018**, *3*, 61– 67

[Poster 02-2]

A High-Performance Transpiration-Driven Electrokinetic Power Generator Using a Conjugated Polymer

Kyung Min Kim [a,#], Hyungsub Yoon[b], Yang Hun Nam [a], Sang Eun Yoon[a], Tae Gwang Yun[a], Jong H. Kim[a,*]
[a]Department of Molecular Science and Technology, Ajou university, Suwon 16499, Republic of Korea
[b]Department of Intelligent Semiconductor Engineering, Chung-Ang University, Seoul 06974, Republic of Korea
Email: jonghkim@ajou.ac.kr

Keywords: Conjugated polymers, Molecular doping, Transpiration-driven electrokinetic power generator, Dopant engineering, Electrokinetic performance

A transpiration-driven electrokinetic power generator (TEPG) leverages the asymmetric wetting of a porous cellulose textile to induce an electrical double layer (EDL), thereby generating a sustained streaming potential from capillary-driven ion transport.[1] To impart ionic-electronic conductivity, the textile substrates were functionalized by sequentially doped conjugated polymer films.[2] For the active layer, poly(2,5-bis(3-tetradecylthiophen-2-yl)thieno[3,2-b]thiophene) (PBTTT) was selected as a model p-type conjugated polymer, which was doped with either gold(III) chloride ($AuCl_3$) or 2,3,5,6-tetrafluoro-7,7,8,8-tetracyanoquinodimethane (F_4TCNQ) to compare their effects on performance. The $AuCl_3$-doped device exhibited superior performance, achieving a maximum open-circuit voltage (V_{OC}) of 0.5 V and a short-circuit current (I_{SC}) of 65 μA, generating 7.5 μW. Our findings underscore simple yet efficient energy harvest from water through TEPG using conjugated polymers.

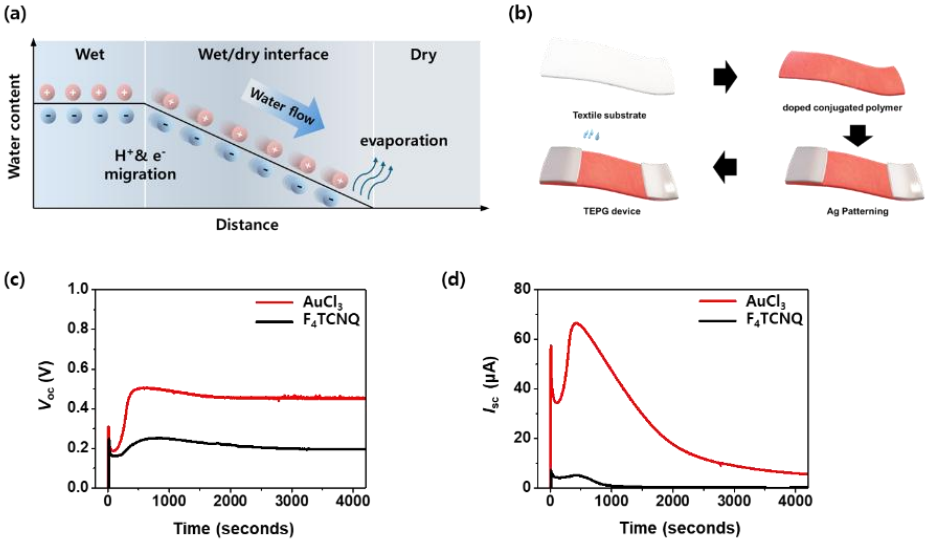


Fig. 1. (a) Schematic illustration of transpiration-driven behavior occurred at wet/dry interface and the mechanism of current generation. (b) Schematic diagram of fabrication process for the TEPG device. Measured (c) V_{OC} and (d) I_{SC} profiles for devices doped with $AuCl_3$ and F_4TCNQ after dropping 60 μL of 0.051 M NaCl solution.

[References]

(1) Yun, T. G.; Bae, J.; Rothschild, A.; Kim, I.-D. *ACS Nano* **2019**, *13*, 12703– 12709

(2) Yun, T. G.; Bae, J.; Nam, H. G.; Kim, D.; Yoon, K. R.; Han, S. M.; Kim, I.-D. *Nano Energy* **2022**, *94*, 106946

[Poster 02-3]

Spectrally Flat Broadband Organic Photodetectors with Photoresponse up to 1400 nm via Using a Fused Thiophene-Based Non-Fullerene Acceptor

Ji Hye Yoon[a,#], Hyeong Ju Eun[a], Ah Young Lee[a], Ji Yeon Son[a], Jong-Woon Ha[b], Jong H. Kim[a,*]
[a]Department of Molecular Science and Technology, Ajou University, Suwon 16499, Republic of Korea
[b]Department of Materials Engineering and Convergence Technology, Gyeongsang National University, Jinju 52828, Republic of Korea
Email: jonghkim@ajou.ac.kr

Keywords: Organic photodetectors, Broadband photodetectors, Non-fullerene acceptor, Active layer thickness, Flat spectral-response

Organic photodetectors (OPDs) are promising for next-generation optoelectronics due to their solution processability, large-area scalability, mechanical flexibility, and low-cost fabrication. In particular, broadband OPDs have attracted interest for applications such as spectroscopic instrumentation and environmental monitoring. A spectrally flat response enables OPDs to function as optical power meters without additional optical components, thereby simplifying the development of reliable radiometric instruments.[1] Here, we report a novel non-fullerene acceptor, 6QCF, designed within acceptor–donor–acceptor (A–D–A) framework. Incorporation of an electron-rich fused thiophene-based core and electron-withdrawing 2-(4-oxonaphthalen-1(4H)-ylidene)malononitrile (QC) end groups functionalized with cyano (–CN) and fluorine (–F) units promotes strong intramolecular charge transfer, yielding 6QCF film with an optical bandgap of 0.96 eV and an absorption edge to 1295 nm. Atomic force microscopy confirmed that PTB7-Th:6QCF blend films with different thicknesses exhibited smooth and uniform morphologies, while the corresponding OPDs maintained comparable dark current densities (~1.44×10^{-5} A cm^{-2} at −0.5 V). Notably, the OPD with a 430 nm-thick active layer achieved a significantly extended photoresponse up to 1400 nm, attributed to Fabry–Perot resonance within an optical cavity. This optimized thickness provided broadband absorption while ensuring efficient charge transport. Ultimately, the devices demonstrated spectrally flat broadband characteristics, retaining more than 50% of their maximum responsivity (R = 85.9 mA W^{-1}) and specific detectivity (D_{shot}^{*} = 4.04×10^{10} Jones) across the ultraviolet to short-wave infrared (380–1290 nm) range. The performance uniformity in this range is further supported by a low relative standard deviation (RSD) of 14%, underscoring the capability for wavelength-independent photodetection. These findings highlight the significance of molecular design and processing control, establishing 6QCF as a compelling candidate for reliable broadband optical sensing.

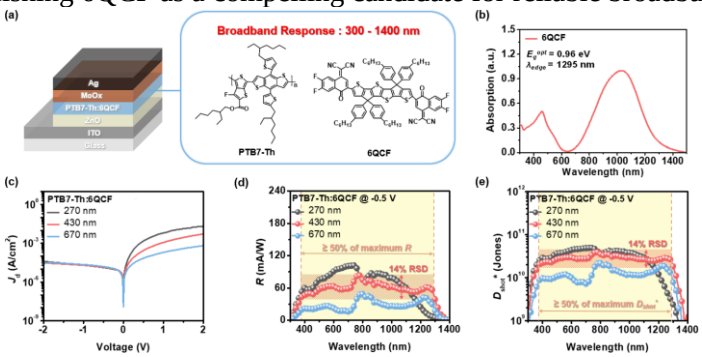


Fig. 1. (a) Chemical and device structures of the PTB7-Th:6QCF-based OPDs. (b) Absorption spectra of 6QCF in film. (c) J−V characteristics in the dark condition. (d) Responsivity (R) and (e) Specific Detectivity (D_{shot}^{*}) spectra of PTB7-Th:6QCF-based OPDs with different thickness under −0.5 V.

[References]

(1) Weng, S.; Zhao, M.; Jiang, D.; Liang, Q. *J. Phys. Chem. Lett.* **2022**, *13*, 10577– 10588

[Poster 02-4]

High-Performance Inverted Perovskite Solar Cells using Carboxylic Acid-Functionalized PTAA as a Hole Transport Layer

Jae Woo Jeong[a,#], Chanhyeok Kim[b], Taiho Park[b], Jun Woo Lee[a], Jong H. Kim[a,*]
[a]Department of Molecular Science and Technology, Ajou University, Suwon 16499, Republic of Korea
[b]Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH) Pohang, Gyeongbuk 37673, Republic of Korea
Email: jonghkim@ajou.ac.kr

Keywords: P-type polymer, Doped hole transport layer, Wettability, Wide-bandgap, Inverted perovskite solar cells

Perovskite solar cells (PSCs) have emerged as a promising next-generation photovoltaic technology due to their high power conversion efficiency (PCE) and low fabrication costs. Among various device architectures, the inverted PSCs are particularly advantageous due to their superior durability and compatibility with low-temperature processing. In this configuration, the hole transport layer (HTL) plays a critical role in determining efficiency and stability. Poly[bis(4-phenyl)(2,4,6-trimethylphenyl)amine] (PTAA) is widely employed as a p-type HTL due to its facile solution processibility, high optical transmittance, mechanical flexibility, and chemical stability.[1] However, its low intrinsic conductivity and hydrophobic surface limit the overall performance of PSCs. To overcome these limitations, we synthesized a new PTAA derivative, carboxylic acid-functionalized PTAA (CA-PTAA), and employed doping to improve charge transport.[2] The introduction of the carboxylic acid groups reduced the surface hydrophobicity of the HTL, thereby enhancing the wettability of the polar perovskite precursor solution.

In a wide-bandgap (~1.67 eV) PSCs, CA-PTAA enabled PCE of 18%, along with improved photovoltaic parameters, outperforming PSCs based on PTAA. Furthermore, doping with lithium bis(trifluoromethanesulfonyl)imide (Li-TFSI) and 4-*tert*-butylpridine (*t*-BP) enhanced the hydrophilic properties of CA-PTAA, reducing its water contact angle from 88.5° to 85°. The doped CA-PTAA facilitated uniform perovskite film formation, suppressed interfacial defects, and improved charge extraction. These results demonstrate that doped CA-PTAA provides a promising approach to improve the PCEs of wide-bandgap PSCs in an inverted structure.

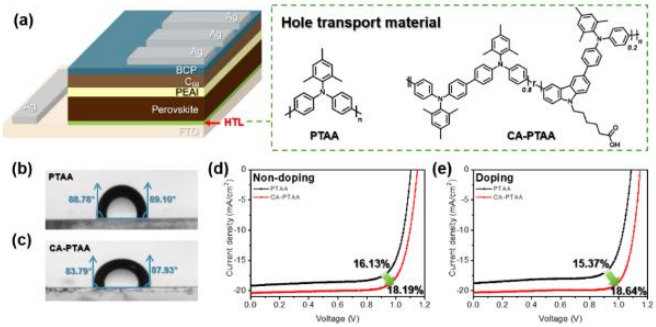


Fig. 1. (a) Schematic inverted perovskite solar cell structure and molecular structure of PTAA and CA-PTAA. Water contact angle of (b) PTAA and (c) CA-PTAA. *J-V* curves of the device (d) without and (e) with doping.

[References]

(1) Wang, Y.; Duan, L.; Zhang, M.; Hameiri, Z.; Liu, X.; Bai, Y.; Hao, X. *Sol. RRL* **2022**, *6* (8), 2200234

(2) Wu, X.; Gao, D.; Sun, X.; Zhang, S.; Wang, Q.; Li, B.; Li, Z.; Qin, M.; Jiang, X.; Zhang, C.; Li, Z.; Lu, X.; Li, N.; Xiao, S.; Zhong, X.; Yang, S.; Li, Z. a.; Zhu, Z. *Adv. Mater.* **2023**, *35*, 2208431

[Poster 02-5]

Pure Organic Visible-to-UV Solid-state Photon Upconversion based on Metal-free Sensitizer and Glassy Emitter Aggregates

Shun Watanabe[a,#], Kiichi Mizukami[a], Nobuo Kimizuka[a], Takuma Yasuda[a,b,*]
[a]Graduate School of Engineering, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan.
[b]Institute for Advanced Study, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan.
Email: yasuda@ifrc.kyushu-u.ac.jp

Keywords: Photon upconversion, Organic glass, Thermally activated delayed fluorescence.

Photon upconversion (UC) is a versatile photophysical process in which low-energy photons are combined to form high-energy photons. Triplet–triplet annihilation upconversion (TTA-UC) has attracted significant attention because of its advantages over other UC techniques, including low excitation intensity requirement, high UC efficiency, and tunable UC emission wavelength. For expansion of the applications, it is desirable to construct efficient solid-state TTA-UC systems. However, the efficiency of solid-state TTA-UC systems is significantly lower than that of diffusion-dependent systems, such as those in conventional liquid media. To date, various approaches to solid-like (or quasi-solid) TTA-UC have been attempted, including using polymer matrix, gel matrix, and solid film systems. However, few reports exist on efficient solid-state visible-to-UV TTA-UC that can be driven with substantially low excitation power.

Herein, we demonstrated pure organic visible-to-UV TTA-UC systems based on diphenylnaphthalene (**DPN**)-derived glassy emitters in combination with multi-resonance thermally activated delayed fluorescence (MR-TADF) sensitizer[1]. For UC emitters, we developed **SiDPN-1** and **SiDPN-2** in which a bulky tetraphenylsilane moiety was introduced to suppress aggregation-caused quenching and to promote the formation of thermodynamically stable glassy solids. These new emitters exhibited high photoluminescence quantum yields in the condensed solid states, comparable to those in solution. The MR-TADF sensitizer exhibited low energy loss associated with intersystem crossing and high triplet exciton generation ability due to the small singlet–triplet energy gap and the heavy atom effect. Owing to their ideal properties, we fabricated highly transparent glassy upconversion films with a thickness of ~1 μm through a simple process consisting of mixing, melting, and rapid cooling (Fig. 1a). Upon irradiation with a 445 nm laser, the films exhibited distinct UC emissions peaking at 370–390 nm (Fig. 1b). As expected, the triplet-mediated UC emissions decayed in millisecond timescale (Fig. 1c). The threshold excitation intensities for the **SiDPN-1**- and **SiDPN-2**-hosted films were as low as 49 and 44 mW cm^{-2}, respectively, and their UC efficiencies, determined by the absolute method, exceeded 2% (Fig. 1d,e).

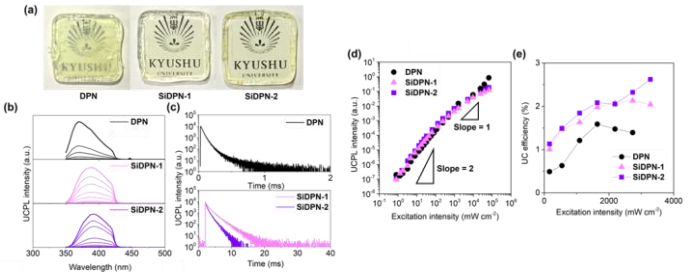


Fig.1 (a) Photos of **DPN**, **SiDPN-1**, and **SiDPN-2** films (15 mm × 15 mm) containing MR-TADF sensitizer. (b) UC emission spectra under photoexcitation at 445 nm and power densities ranging from 0.8 mW cm^{-2} to 67 W cm^{-2}, (c) UC emission decay curves, (d) UC efficiency as a function of excitation power density, and (e) double logarithmic plots of UC emission intensity *versus* excitation power density.

[References]

(1) S. Watanabe, K. Mizukami, N. Kimizuka, T. Yasuda, *J. Mater. Chem. C*, **2024**, 12, 10874.

[Poster 02-6]

Decoupling of Colloidal Perovskite Quantum Dots for Deep-Blue Light-Emitting Diodes

Kyung Yeon Jang[a,#], Shin Young Hwang[a], Tae-Woo Lee[a,*]
[a]Department of Materials Science and Engineering, Seoul National University,1 Gwanak-ro, Gwanak-gu, Seoul 08826, Republic of Korea
Email: twlees@snu.ac.kr

Keywords: Perovskite, Quantum dot, Light-emitting diodes, deep-blue

Metal halide perovskite LEDs have received substantial interest due to their exceptional color purity, satisfying the Rec. 2020 color gamut standard, and impressive efficiency in pure-green and pure-red perovskite nanoparticle LEDs. However, the challenge lies in achieving high efficiency in the deep-blue region, an area hitherto under-explored. This study focuses on using $CsPbBr_3$ quantum dots (QDs) as the light-emitting layer in perovskite LEDs (PeLEDs). We identify two obstacles that need to be overcome: the difficulty in ligand post-treatment and the spectrum red-shift in the film state.

Here, we propose an alternative ligand enriched with a chemical passivation process, effectively amplifying the photoluminescence quantum yield (PLQY) of deep-blue QDs from 15% to nearly 90%. Furthermore, to address the spectrum red-shift induced by energy transfer or electronic coupling, we introduce a QD-in-host structure to physically segregate the QDs during the film state. A reduction in the concentration of QDs yielded a blue-shift of approximately 7 nm in the emission spectrum. By incorporating these innovative strategies, we achieved a maximum external quantum efficiency of 6.2% at a peak wavelength of 461 nm.[1] The findings of this study provide crucial strategies for deep-blue QD PeLEDs, which hold potential for broad applicability across diverse PeLED types.

[References]

(1) Jang, K. Y.; Hwang, S. Y.; Woo, S.-J.; Yoon, E.; Park, C.-Y.; Kim, S. Y.; Kim, D.-H.; Kim, H.; Park, J.; Sargent, E. H.; Lee, T.-W. *Adv. Mater.* **2024**, *36*, 2404856

[Poster 02-8]

Solution-processed growth of SnS_2 single crystal

Hyein Hwang[a,#], Jae Sung Son[a,*]
[a]Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang 37673, Gyeongsangbuk-do, Republic of Korea
Email: sonjs@postech.ac.kr

Keywords: Solution process, SnS_2

Two-dimensional (2D) metal chalcogenide semiconductors have emerged as promising materials for next-generation electronic and optoelectronic devices. Single crystals are grown using methods such as MBE, CVD, etc. In contrast, solution-processed methods, while still relatively unexplored, offer scalable and cost-effective manufacturing potential. In this study, we present a solution-based strategy for growing SnS_2 single crystals via a solution process. The morphology of the crystals was analyzed using OM and SEM images, and the crystal structure was analyzed using XRD.

[Poster 02-9]

Fabrication of Inorganic 3D Architectures via Chemical Coupling of Nanocrystals

Minseong Park[a,#], Jae Sung Son[a,*]
[a]Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang 37673, Republic of Korea.
Email: sonjs@postech.ac.kr

Keywords: 3D microprinting, Inorganic nanocrystals, Metal ion crosslinking

Three-dimensional (3D) microprinting is an emerging technique but remains constrained by reliance on photocurable resins, costly systems, and polymer-centric materials. We report a nanoparticle-based approach enabling direct construction of inorganic architectures such as metals, semiconductors, and magnetic materials. The strategy integrates nanocrystal synthesis, surface modification with inorganic ligands, and instant solidification via metal ion linkers. With Au, CdSe and FePt nanocrystals, we achieved microfilament deposition in a reactive bath and realized intricate 3D lattices, broadening inorganic options for microscale additive manufacturing.

[Poster 02-10]

Aromatic 2,2-diphenyletylamine Ligand Exchange of FA0.9Cs0.1PbBr3 Perovskite Nanocrystals for High Efficiency Pure Green Light-Emitting Diodes

Shoki Mizoguchi[a,#], Takayuki Chiba[a,*]
[a]Graduate School of Organic Materials Science, Yamagata University,
4-3-16 Jonan, Yonezawa, Yamagata 992-8510, Japan.
Email: t-chiba@yz.yamagata-u.ac.jp

Keywords: perovskite nanocrystals, ligand exchange, aromatic compounds, LEDs

Perovskite nanocrystals (NCs) are rapidly gaining attention as next-generation optoelectronic device materials due to their high optical absorption coefficients, long carrier diffusion lengths, and composition-tunable bandgaps. For optoelectronic devices such as light-emitting diodes (LEDs), solar cells, and photodetectors, it is essential to suppress structural defects and achieve efficient charge injection and transport [1]. However, conventional insulating ligands hinder charge mobility and exhibit poor compatibility with other materials, thereby limiting composite film fabrication. To overcome these challenges, ligand exchange with short-alkyl chain, aromatic, or host-like ligands has been explored to enhance electronic properties and material compatibility [2,3]. In this study, we introduced 2,2-diphenylethylamine (DPEA), an aromatic ligand, to improve charge injection and transport in green NC-LEDs. In addition, DPEA enabled the formation of composite films with small-molecule hosts containing aromatic structures.

A-site mixed-cations $FA_{0.9}Cs_{0.1}PbBr_3$ NCs were synthesized via the ligand-assisted reprecipitation (LARP) method. During the purification process, the aromatic ligand DPEA was dissolved in the low-dielectric-constant dimethyl carbonate, enabling simultaneous purification and ligand exchange of the NCs. After ligand exchange, proton nuclear magnetic resonance (^{1}H-NMR) analysis was performed to estimate the detailed surface composition of the control-NCs and DPEA-NCs using ferrocene as an internal standard. The phenyl resonance was clearly observed for the DPEA-NCs. The DPEA-NCs film exhibited a pure green wavelength of 530 nm and full-width at half-maximum of 20.9 nm with a photoluminescence quantum yield of 90.9%. The DPEA-NC-LED achieved a luminance of 39700 cd/m^2 and external quantum efficiency of 18.6% even in a thick NC film. Interestingly, the DPEA-NCs formed a composite film with small-molecule tris(4-carbazoyl-9-ylphenyl)amine (TCTA). (Fig. 1a) The operational stability of this composite LED was eight times higher than that of the DPEA-NC-LED owing to enhanced hole–electron charge balance and the suppression of perovskite NCs degradation. (Fig. 1b) Overall, the aromatic ligand DPEA not only enables the fabrication of high-efficiency NC-LEDs but also improves their dispersibility with host materials.

In conclusion, aromatic ligand DPEA exchange enhanced charge injection and transport, preserved high efficiency in thick films, and enabled composite formation with aromatic hosts. These results demonstrate that DPEA is an effective strategy to achieve both high efficiency and improved stability in NC-LEDs. [4]

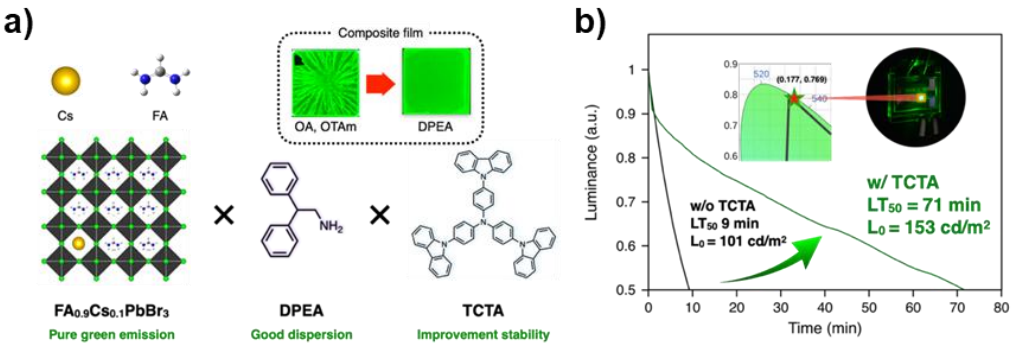


Fig. 1. a) Schematic diagram of this study b) Operational device lifetime

[References]

(1) M. I. Saleem *et al*, *Nano Energy*, **2025**, *142*, 111272

(2) Q. PAN *et al*, *ChemSusChem*, **2025**, *18*, e202401875

(3) H. Abe *et al*, *Small*, **2025**, *21*, 2501159

(4) S. Mizoguchi *et al*, *ACS Omega*, **2024**, *9*, 34692

[Poster 02-11]

Controlling Emission Wavelengths of Sn/Ge Halide Nanocrystals via Mixed Halides Composition

Sana Kakizaki[a], Yutaka Fuzimoto[b], Takayuki Chiba[a,*]
[a]Graduate School of Organic Materials Science, Yamagata University,
4-3-16 Jonan, Yonezawa, Yamagata 992-8510, Japan
[b]Department of Applied Chemistry, Graduate School of Engineering, Tohoku University,
6-6-07 Aoba, Aramaki, Aoba-ku, Sendai 980-8579, Japan
Email: t-chiba@yz.yamagata-u.ac.jp

Keywords: Sn/Ge halide nanocrystals, lead-free, mixed halides

Lead halide perovskite nanocrystals (NCs) have attracted considerable attention as next-generation light-emitting materials due to their high photoluminescence quantum yield (PLQY) and tunable emission wavelengths in the visible region. However, their practical application is hindered by the toxicity of lead, prompting the demand for environmentally benign alternatives. Lead-free halide nanocrystals, particularly those based on tin, often suffer poor stability low PLQYs due to facile Sn oxidation [1]. In this study, we explore mixed tin/germanium (Sn/Ge) halide NCs as a lead-free system, aiming to improve both PLQY and oxidation resistance. Furthermore, we achieved emission wavelength control via halogen substitution.

Sn/Ge halide NCs were synthesized via a hot-injection method by introducing a cesium precursor into a mixed precursor solution of tin(II) bromide ($SnBr_2$) and germanium(II) bromide ($GeBr_2$). Transmittance electron microscope (TEM) showed an average particle size of 103 nm (Fig. 1a). Solid-state Sn/Ge halide NCs powders were obtained without aggregation through repeated precipitation with a poor solvent and subsequent vacuum drying. These powders exhibited broad orange emission centered at 630 nm with a full width at half maximum (FWHM) of 150 nm and an exceptionally high PLQY exceeding 90%. Remarkably, the PLQY remained above 80% even after two years, demonstrating outstanding long-term stability. In ambient air, the powders retained their emission wavelength for at least three days, confirming strong air stability.

Post-synthetic halogen exchange was demonstrated by treating the NC powders with oleylammonium iodide (OAmI) in hexane[2], enabling precise emission wavelength tuning through Br/I substitution. In addition, the use of tri-n-octylphosphine (TOP) during synthesis facilitated the incorporation of poorly soluble tin(II) iodide (SnI_2) and germanium(II) iodide (GeI_2), including a red-shift of the emission up to 688 nm (Fig. 1b). Furthermore, the NCs exhibited radioluminescence (PL) under X-ray irradiation, indicating their potential application as scintillators with minimal self-absorption (Fig. 1c).

We successfully synthesized novel Sn/Ge mixed halide NCs that combine high PLQY with remarkable stability, addressing long standing challenges in lead-free perovskite NCs. Tunable emission wavelength via halogen exchange and scintillation response under X-ray irradiation highlight their potential for advanced optoelectronic and radiation detection applications.

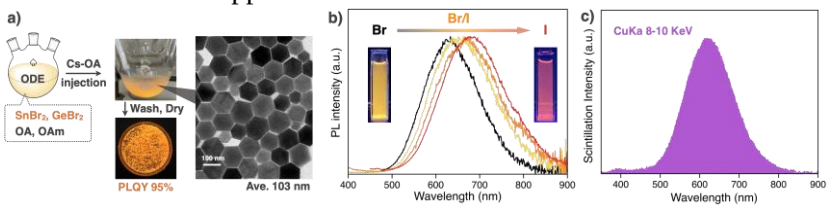


Fig 1. a) Synthesis and TEM image, b) PL spectra upon halogen substitution, c) RL spectra of powder

[References]

(1) I. L. Fernández et al., *Adv Funct Mater*. **2023**, 2307896

(2) T.Chiba et al., *Nat. Photon.* **2018**, *12*, 681-687

[Poster 02-12]

Controlling Morphology and Aggregates Using Volatile Solid Additives to Enhance OPV Performance

Akira Sato[a], Riko Otomo[a], Taisei Kotaka[a], Hisahiro Sasabe[a,*], Takeshi Sano[a,b,*]
[a] Department of Organic Materials Science, Yamagata University,
4-3-16 Jonan, Yonezawa, Yamagata, 992-8510, Japan
[b] Innovation Center for Organic Electronics, Yamagata University, 1-808-48 Arcadia, Yonezawa, Japan
Email: h-sasabe@yz.yamagata-u.ac.jp, takeshi.sano@yz.yamagata-u.ac.jp

Keywords: Organic photovoltaic cells, Organic solar cells, Volatile solid additives, Morphology, Aggregate

Organic photovoltaic (OPV) cells are promising next-generation solar devices because they are lightweight, flexible, and semitransparent. Although their efficiency has improved in recent years, further enhancement of power conversion efficiency (PCE) and long-term stability is still needed [1]. A common strategy is the bulk heterojunction (BHJ) structure, where donor and acceptor materials are mixed to promote exciton separation and balanced charge transport. The nanoscale morphology of the active layer is crucial, as domain size and purity strongly affect charge recombination and carrier mobility. Traditionally, high-boiling-point solvent additives have been used to control morphology, but their low volatility can leave residues that reduce stability and reproducibility. Volatile solid additives offer a practical alternative, as they can fully evaporate during film formation [2]. In this study, we examined volatile solid bromide additives and how they control aggregate formation of non-fullerene acceptors, aiming to improve active layer morphology and OPV device performance.

In this study, three volatile solid additives, 1,2,3-Tribromobenzene (1,2,3-TBB), 1,2,4-Tribromobenzene (1,2,4-TBB), and 1,3,5-Tribromobenzene (1,3,5-TBB), were examined for their effects on OPV devices. The active layer was prepared by dissolving donor PM6, acceptor Y6-12, and each additive in chloroform, followed by film deposition using the spin-coating method. The device structure was [ITO / PEDOT:PSS (30 nm) / Active layer (100 nm) / PDINN (5 nm) / Ag (100 nm)]. XPS analysis confirmed that the additives could be completely removed from the active layer by thermal treatment at 100 °C for 5 minutes. The devices processed with these additives exhibited good power conversion efficiencies (Figure 1). In particular, the devices using 1,3,5-TBB achieved the highest PCE of 15.34%. The additives were also effective in improving the fill factor, likely due to reduced series resistance and enhanced carrier transport. Moreover, UV-vis absorption spectroscopy indicated that the dipole moments of the additives regulated the aggregation of acceptor molecules, leading to pronounced differences in aggregate structures and film morphologies (Figure 2). These findings demonstrate that volatile bromide additives can serve as practical and efficient morphology-control agents for OPV devices.

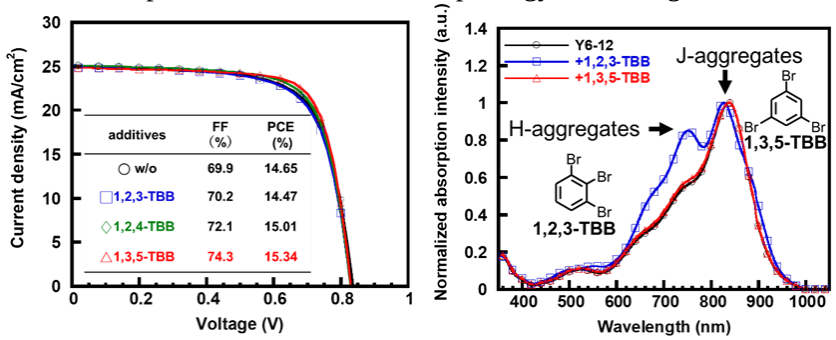


Fig 1. J-V characteristics of the cells and UV-vis absorption of Y6-12 films with TBB additives after annealing process.

[References]

(1) H. Ninoto, A. Sato *et al.*, *A-COE 2024 The 16th Asian Conference on Organic Electronics*, **2024**, p36.

(2) Runnan Yu *et.al.*, *Nat. Commun.*, **2018**, *9*, 4645.

[Poster 02-13]

Synthesis of Narrow-Luminescent Organic Small Molecules Containing Dibenzofuran

Yu-An Lu[a,#], Tzu-Ying Yen[a], Yi-Ting Lee[a,*]
[a]Department of Chemistry, Soochow University, Taipei City 111, Taiwan
Email: leeyiting@scu.edu.tw

Keywords: Multi-resonance narrow luminescence molecules, organic light-emitting devices

Multi-resonance narrow luminescent molecules face the same material stability issues and challenges as blue organic materials generally used in optoelectronic devices. Organic molecules used in optoelectronic devices must not only have good thermal stability but also good stability in the excited state when illuminated and powered. The dibenzofuran (DBF) unit exhibits excellent stability and enhances electron transport capacity. Many host materials or electron transport materials used in organic light-emitting diodes (OLEDs) have dibenzofuran units. This research links the highly stable DBF unit with the narrow-luminescence multi-resonance center, 2-(tert-butyl)-5-oxa-8b-aza-15b-borabenzo[a]naphtho[1,2,3-hi]aceanthrylene (BNO), to synthesize molecules that are both highly stable and exhibit narrow luminescence. In addition to connecting the DBF group, a further step is to replace a phenyl group on DBF with a naphthyl group to synthesize naphtho[2,3-b]benzofuran (NBF) to reduce the triplet energy level of the molecule. The high triplet energy level of blue-emitting materials has long been a primary factor limiting the lifespan of blue OLEDs. By regulating the substitution site of functional groups and the properties of electron donors and acceptors, the luminescent wavelength and efficiency of the molecule can be further optimized. These research results have potential applications in developing synthesis conditions for narrow-luminescence materials and in organic light-emitting diode (OLED) technology.

Building on this design strategy, three blue MR-type molecules—BNO-3-DBF, BNO-4-DBF, and BNO-3-NBF—were synthesized to investigate the influence of different substitution positions and structural variations on optical and electronic performance. Comprehensive photophysical characterization confirmed that these molecules not only retain excellent thermal and excited-state stability but also achieve improved emission profiles and efficiency. The successful development of these DBF-modified MR emitters underscores their promise as stable, high-efficiency blue light sources, offering a feasible route toward next-generation OLEDs with longer operational lifetimes.

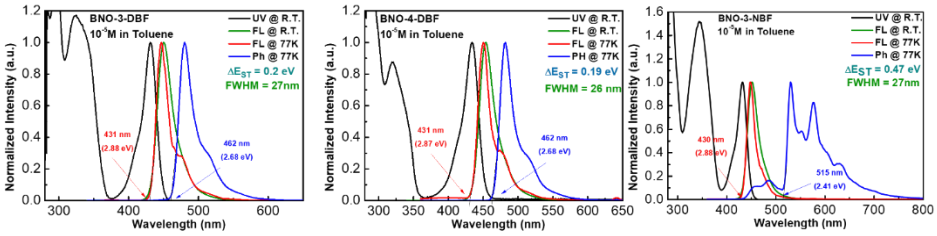


Fig. 1. Normalized UV–vis absorption and photoluminescence (PL) spectra of (a) BNO-3-DBF, (b) BNO-4-DBF, and (c) BNO-3-NBF in degassed toluene (10^{-5} M) at room temperature. Emission maxima (λ_{max}), full width at half maximum (FWHM), and singlet–triplet energy gaps (ΔE_{ST}) are indicated for each compound.

[References]

(1) Cho, S. M.; Youn, K. M.; Yang, H. I.; Lee, S. H.; Naveen, K. R.; Karthik, D.; Jeong, H.; Kwon, J. H. *Org. Electron.* **2022**, *105*, 106501

(2) H. Li, H. Yan, L. Meng, X. Zhang, C. Kuang, Z. Meng, Y. He, H. Xu, X. Zhang, Y. Zheng, C. Yan, H. Meng, *J. Mater. Chem. C* **2023**, *11*, 15548

[Poster 02-14]

Dibenzofuran-Engineered High Bond Dissociation Energy Hole Transport Materials for Efficiency and Longevity of Quantum Dot Light-Emitting Diodes

Youngjun Hwang[a,#] and Youngu Lee[a,*]
[a] Department of Energy Science & Engineering, Daegu Gyeongbuk Institute of Science and Technology (DGIST), 333, Techno Jungang Daero, Hyeonpung-Eup, Dalseong-Gun, Daegu, 42988, Republic of Korea.
Email: youngulee@dgist.ac.kr

Keywords: quantum dot, light-emitting diode, hole transport material, bond dissociation energy, dibenzofuran

Quantum dot light-emitting diodes (QLEDs) have received great attention in display and lighting technologies owing to their precise color tunability, high color purity, and near-unity luminance efficiency. However, their efficiency and operational lifetime remain constrained by the lack of hole transport materials (HTMs) that concurrently afford efficient hole transport properties and electrical robustness. For example, widely used polymeric HTMs possess shallow HOMO energy levels, weak electron blocking properties, and fragile phenyl–nitrogen (N) bonds that dissociate under electrical stress. These limitations arise from intrinsic trade-offs among hole transport properties, electron-blocking capability, and bond dissociation energy (BDE), which have precluded most prior HTM studies from simultaneously achieving all three. To overcome these challenges, we designed and synthesized a series of dibenzofuran (DBF)–incorporated HTMs engineered for high bond dissociation energy (BDE). Computational and experimental results show deeper HOMO energy levels, improved hole transport properties, and higher BDEs across the series. Among them, poly(9,9-dioctylfluorene-co-N,N-diphenyldibenzofuran-1-amine) (1-PFDBF) exhibits the deepest HOMO energy level and the highest hole mobility, thereby improving charge balance. Moreover, its extended exciton lifetime and reduced trap density enhance electron blocking capability. As the results, solution-processed green QLEDs using 1-PFDBF achieve a maximum external quantum efficiency of 25.71%, a maximum current efficiency of 102.98 cd A^{-1}, a maximum power efficiency of 75.69 lm W^{-1}, and a low turn-on voltage of 2.25 V, surpassing TFB-based QLEDs. Moreover, 1-PFDBF–based QLEDs also exhibit exceptional stability with $T_{50} \approx 1{,}460{,}000$ h at 100 cd m^{-2}.

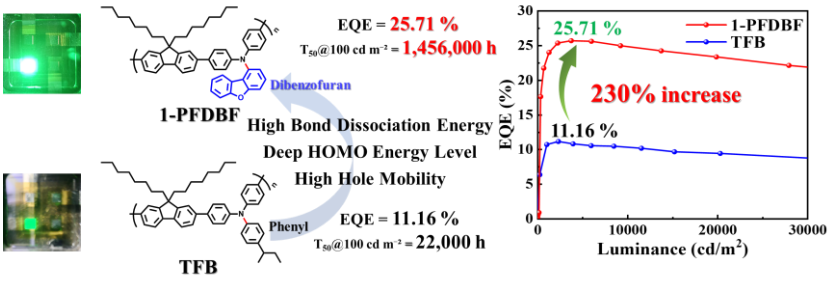


Fig. 1 Performance comparison of green QLEDs employing 1-PFDBF and TFB as the HTM.

[References]

(1) Y. Hwang, H. Jung, J. Kim, D. Lee, Y. Lee, *Small* **2025**, *21*, e04867.

[Poster 02-15]

Investigation of Photophysical and Structural Characteristics of Low-Triplet Anthracene-Derived Multiple-Resonance Emitters

Cheng-Yang Li[a,#], Yi-Ting Lee[a,*]
[a]Department of Chemistry, Soochow University, Taipei City 111, Taiwan
Email: leeyiting@scu.edu.tw

Keywords: Multiple resonance (MR) emitters, Anthracene derivatives, Low triplet energy

Conventional multiple-resonance (MR) materials possess relatively small singlet–triplet energy gaps (ΔE_{ST}), which enable efficient utilization of triplet excitons through the reverse intersystem crossing (RISC) process. The rapid radiative decay of these excitons contributes to longer device lifetimes while maintaining a high photoluminescence quantum yield (PLQY). MR-type blue emitters constructed from polycyclic aromatic compounds containing boron and nitrogen atoms typically exhibit well-separated highest occupied molecular orbital (HOMO) and lowest unoccupied molecular orbital (LUMO) levels, resulting in narrow emission spectra and excellent color purity. However, their inherently high triplet energies often present challenges for long-term stability.To address this issue, we incorporated multi-substituted anthracene units into MR frameworks, which effectively reduce triplet energy and enhance molecular rigidity. Furthermore, the introduction of bulky substituents provides steric hindrance that modulates host–guest interactions, thereby improving thermal stability and processing tolerance.

In this work, we successfully synthesized two MR emitters, **BNOPAP** and **BNOA3Ph**, both featuring modified anthracene moieties. Their photophysical properties were systematically investigated to elucidate the influence of aromatic substitution patterns on molecular characteristics. The results demonstrated that this molecular design strategy effectively tunes triplet energy, enhances color purity, and preserves key features such as a narrow full width at half maximum (FWHM) and high PLQY. Overall, this study highlights a promising molecular design approach for improving exciton management, thermal robustness, and device performance, offering a viable pathway toward the development of high-efficiency, long-lifetime OLED materials.

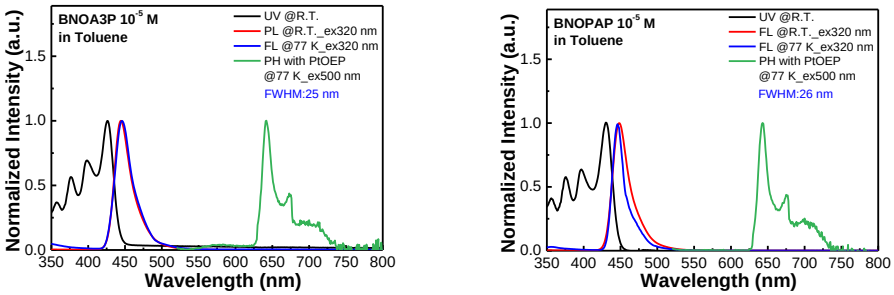


Fig. 1. The photophysical properties of BNOPAP, and BNOA3P in Toluene.

[References]

(1) Tianjiao Fan, Qiwei Liu, Lian Duan, Dongdong Zhang, *J. Mater. Chem. C*, **2024**, *12*, 7989–7995.

(2) K. Suzuki, S. Kubo, K. Shizu, T. Fukushima, A. Wakamiya, Y. Murata, C. Adachi, & H. Kaji, *Angew. Chem. Int. Ed*. **2015**, *54*, 15231.

(3) S. Oda, M. Tanaka, Y. Tsuchiya, C. Adachi, T. Hatakeyama, Adv. Mater., 2019, 31, 1900614

(4) H. Hirai, K. Nakajima, S. Nakatsuka, K. Shiren, J. Ni, S. Nakamura, T. Hatakeyama, *Angew. Chem. Int. Ed.*, **2015**, *54*, 13581–13585.

[Poster 02-16]

Photothermally Cross-Linkable Polymeric Hole Transport Material with Azide Groups for Efficient and Stable Quantum Dot Light-Emitting Diodes

Jaehyeon Kim[a,#], Youngjun Hwang[a], and Youngu Lee[a,*]
[a]Department of Energy Science & Engineering, Daegu Gyeongbuk Institute of Science and Technology (DGIST), 333, Techno Jungang Daero, Hyeonpung-Eup, Dalseong-Gun, Daegu, 42988, Republic of Korea.
Email: youngulee@dgist.ac.kr

Keywords: photothermal, cross-linkable, hole transport material, quantum dot, light-emitting diode

Quantum dot light-emitting diodes (QLEDs) are garnering considerable attention owing to their excellent color purity, tunable emission spectra, solution processability, and scalability to large-area fabrication. However, their efficiency and operational stability remain limited by interlayer erosion of the hole transport layer (HTL) and the quantum-dot (QD) emissive layer during solution processing. Cross-linkable hole transport materials (HTMs) have emerged as an effective strategy to enhance solvent resistance, interfacial stability, and hole transport properties while suppressing current leakage. Nevertheless, many reported cross-linkable HTMs require high cross-linking temperatures and long curing times or rely on photoinitiators under high-energy ultraviolet (UV) irradiation—conditions that can adversely impact device performance. Consequently, it is critical to develop cross-linkable HTMs that combine efficient hole transport properties with rapid cross-linking. In this work, we designed and synthesized an azide-functionalized poly(9,9-dioctylfluorene-co-N-(4-butylphenyl)diphenylamine) (TFB) derivative, denoted TFB-N_3. TFB-N_3 undergoes photothermal cross-linking with only 30 s of UV irradiation at 140 °C, forming a compact three-dimensional network that promotes efficient hole injection and reduces leakage current. In addition, the cross-linked TFB-N_3 exhibits a deeper highest occupied molecular orbital (HOMO) energy level than pristine TFB, lowering the hole injection barrier, improving charge balance, and thereby enhancing overall device performance. As a result, QLEDs incorporating photothermally cross-linked TFB-N_3 show a maximum external quantum efficiency of 19.53%, representing an improvement of 61 % over TFB-based QLEDs. Moreover, the operational lifetime is significantly extended with T_{90} 4.49-fold longer than that of the TFB-based QLEDs.

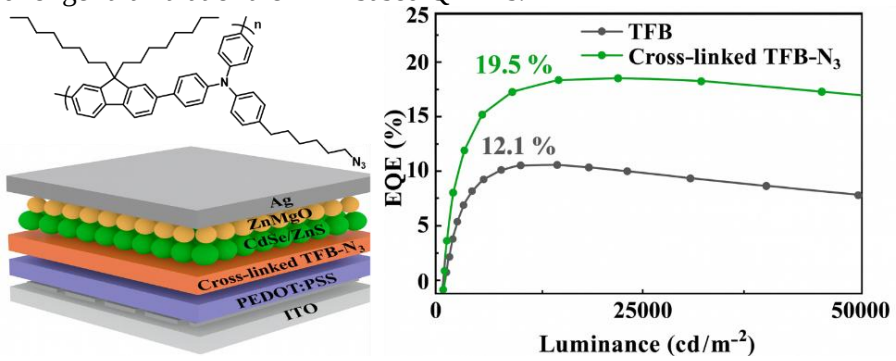


Fig. 1. Performance comparison of QLEDs employing Cross-linked TFB-N_3 and TFB as the HTM

[References]

(1) Y. Hwang, H. Jung, J. Kim, J. Park, A. Maheshwaran, B. Kang, Y. Lee, *ACS Appl. Mater. Interfaces* **2025**, *17*, 6668

[Poster 02-17]

Development of Low-Triplet-Energy Multiple-Resonance Emitters Incorporating Pyrene and Anthracene

Yu-Hsuan Chiang[a,#], Yi-Ting Lee[a,*]
[a]Department of Chemistry, Soochow University, Taipei City 111, Taiwan
Email: leeyiting@scu.edu.tw

Keywords: Multiple resonances, organic light-emitting devices

To address the limited operational stability of blue organic light-emitting devices (OLEDs) caused by the long-lived, high-energy triplet states of thermally activated delayed fluorescence (TADF) materials, we investigated blue multiple-resonance (MR) emitters that inherently lack TADF characteristics. These MR materials exhibit a large singlet–triplet energy gap (ΔE_{ST}), enabling efficient triplet exciton harvesting via Dexter transfer from auxiliary dopants, followed by rapid radiative decay. This mechanism enhances device lifetime while maintaining a high photoluminescence quantum yield (PLQY) and excellent color purity.

Triplet–triplet annihilation (TTA) emission occurs when two triplet excitons combine to generate one singlet exciton, which then radiatively decays to emit fluorescence. This process enables photon upconversion from low-energy triplets to higher-energy singlet emission, making TTA valuable for OLEDs, photovoltaics, and upconversion materials, though its efficiency is fundamentally capped at 50%. In this study, we introduced low-triplet-energy anthracene units into the MR framework to suppress TADF behavior. Two new compounds—**BNOAnNa**, and **BNOAnPyr**—were synthesized to investigate the photophysical impact of anthracene substitution at different molecular positions. Furthermore, the introduction of bulky steric substituents enabled emission tuning from blue to deep blue, thereby improving color purity. Importantly, these modifications preserved key features such as a narrow full width at half maximum (FWHM) and low driving voltage, making these emitters strong candidates for next-generation, high-performance blue OLEDs.

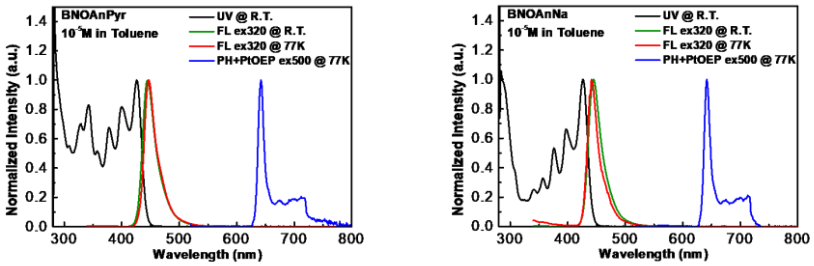


Fig. 1. UV&FL emission spectra of BNOAnPyr and BNOAnNa in Toluene

[References]

(1) Y.-T. Lee, C.-Y. Chan, N. Matsuno, S. Uemura, S. Oda, M. Kondo, R. W. Weerasinghe, Y. Hu, G. N. I. Lestanto, Y. Tsuchiya, Y. Li, T. Hatakeyama, C. Adachi, *Nat. Commun.* **2024**, *15*, 3174

(2) Y.-T. Lee, C.-Y. Chan, M. Tanaka, M. Mamada, K. Goushi, X. Tang, Y. Tsuchiya, H. Nakanotani, C. Adachi, *Adv. Opt. Mater.* **2022**, *10*, 2200682

(3) Beijing Eternal Material Technology Co., Ltd.China, CN104649955 A 2015-05-27

(4) DUKSAN HI METAL - KR101896008, 2018, B1

(5) SAMSUNG DISPLAY - KR2016/30001, 2016, A

[Poster 02-18]

Benzodifuran as a Building Block for Low-threshold, Stable Organic Laser Emitters

Shota Fukuma[a,b,#] and Chihaya Adachi[a,b,c,*]
[a]OPERA, Kyushu University, 744 Motooka, Nishi, Fukuoka 819-0395, Japan.
[b]Department of Applied Chemistry, Kyushu University, 744 Motooka, Nishi, Fukuoka 819-0395, Japan.
[c]I2CNER, Kyushu University, 744 Motooka, Nishi, Fukuoka 819-0395, Japan
Email: adachi@opera.kyushu-u.ac.jp

Keywords: Organic semiconductor laser, Amplified spontaneous emission, Threshold, Stability**.**

Thin-film organic lasers are emerging as next-generation optoelectronic devices for diverse applications, owing to their unique advantages such as high emission color tunability, low-cost fabrication, and excellent mechanical flexibility.[1] However, a major challenge in this field lies in the high threshold for stimulated emission and limited operational stability. Most current low-threshold organic laser emitters are based on photochemically fragile stilbene-based building blocks,[2] which suffer from poor stability and restrict molecular design. Therefore, the development of novel, robust building blocks is essential to overcome these limitations.
In this study, we focus on benzo[1,2-b;4,5-b']difuran (**BDF**) as a new core structure, featuring a rigid and stable framework,[3,4] linearly extended π-conjugation, and ease of synthetic modification. We demonstrate that de novo-designed **BDF** derivatives can simultaneously reduce the amplified spontaneous emission (ASE) threshold and enhance photostability. Two derivatives, **BDF1** and **BDF2**, exhibited nearly quantitative photoluminescence quantum yields and fast radiative decay rates in **CBP**-doped films at optimized concentrations. The ASE thresholds of these doped films were measured to be 0.56 and 0.25 μJ/cm², respectively—both lower than those of the current benchmark material, **BSBCz**. Furthermore, the photostability under continuous-wave laser excitation was significantly improved; **BDF1**, for example, showed a 15.1-fold longer decay half-life compared to **BSBCz**. In this presentation, we will discuss the detailed photophysical behaviors, molecular design principles, and structure–property relationships of these newly developed **BDF**-based laser materials.

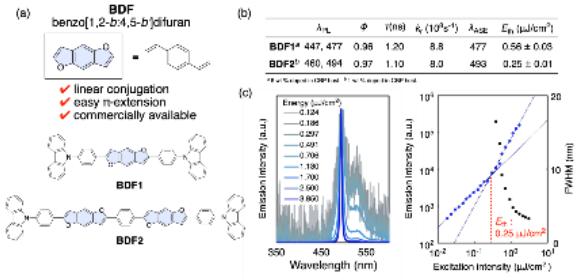


Fig 1. New design of organic laser emitters in this work. (a) Characteristics of the **BDF** framework and the chemical structures of **BDF1** and **BDF2**. (b) Photophysical parameters of **BDF1** and **BDF2**. (c) ASE emission of 1 wt % **BDF2** thin film in **CBP**.

[References]

(1) I. D. W. Samuel, G. A. Turnbull, *Chem. Rev.* **2007**, *107*, 1272.

(2) X. Tang, C. A. M. Senevirathne, T. Matsushima, A. S. D. Sandanayaka, C. Adachi, *Adv. Mater.* **2024**, *36*, 2211873.

(3) Y. Oyama, M. Mamada, A. Shukla, E. G. Moore, S.-C. Lo, E. B. Namdas, C. Adachi, *ACS Mater. Lett.* **2020**, *2*, 161.

(4) H. Tsuji, E. Nakamura, *Acc. Chem. Res.* **2017**, *50*, 396.

[Poster 02-19]

Scaffold Induced Phase-controlled Crystallization for Thermally Evaporated Perovskite Light-Emitting Diodes

Chan-Yul Park[a,#], Joo Sung Kim[a,b], Xian Wei Chua[b], Samuel D. Stranks[b], Tae-Woo Lee[a,*]
[a]*Department of Materials Science and Engineering, Seoul National University, Seoul 08826, Republic of Korea*
[b]*Department of Chemical Engineering and Biotechnology, University of Cambridge, Cambridge, UK*
Email: twlees@snu.ac.kr

Keywords: Thermally evaporated perovskite LEDs, Phase-controlled crystallization, *In-situ* crystallization, Narrow emission linewidth, High-efficiency

Vapor-phase synthesis of perovskites is promising for industrial displays. Yet, the process remains challenging due to uncontrolled crystallization of mixed 3D, 2D, and 0D phases that broaden emission and limit device efficiency. To address this issue, controlled *in-situ* crystallization during the thermal evaporation process is necessary to obtain both strong exciton confinement and effective charge transport simultaneously. Here, we developed a scaffold as an underlaying template layer that guides the crystallization route of quasi-2D perovskite layers, ensuring both dimensional and spatial homogeneity of the medium-*n* quasi-2D phases. With strong exciton confinement in homogeneous energy landscape, the resulting films exhibited a high photoluminescence quantum yield (PLQY) of 85% and narrow emission linewidth (FWHM = 17 nm). By leveraging homogeneously distributed phases of quasi-2D perovskites, perovskite light-emitting diodes (PeLEDs) demonstrated ultra-narrow EL spectra (linewidth = 77 meV) and a record high external quantum efficiency (EQE) to date for thermally evaporated PeLEDs.

[Poster 02-20]

Unveiling the Effect of Molecular-Weight on Charge Transport and Polaron Formation in Ion-gel Gated Organic Synaptic Transistors

Hyun-Haeng Lee[a,#], Min-Jun Sung[a], Katherine Stewart[b], Jaeho Lee[c], Hyunwoo Park[d], Tae-Lim Choi[d], Ji-Seon Kim[b], and Tae-Woo Lee[a,e,f,*]

[a]Department of Materials Science and Engineering, Seoul National University, Seoul, Republic of Korea
[b]Department of Physics and Centre for Processable Electronics, Imperial College London, London, UK
[c]Department of Chemistry, Colorado State University, CO, USA
[d]Department of Materials, ETH Zürich, 8093 Zürich, Switzerland
[e]Research Institute of Advanced Materials, Institute of Engineering Research, Soft Foundry, Interdisciplinary Program in Bioengineering, Seoul National University, Seoul, Republic of Korea
[f]SNDisplay Co., Ltd., 1 Gwanak-ro, Gwanak-gu, Seoul, Republic of Korea
Email: twlees@snu.ac.kr

Keywords: Ion-gel gated organic synaptic transistors, organic semiconductors, neuromorphic electronics

Organic neuromorphic electronics are gaining attraction for wearable, bio-hybrid, and robotic systems owing to their mechanical flexibility, biocompatibility, and chemical tunability. Devices that leverage electrochemical doping are especially promising for low-power operation and high signal-to-noise ratios, yet the influence of intrinsic organic semiconductor (OSC) parameters—particularly molecular weight and polydispersity—on electrochemical doping of OSCs remains underexplored. Here, we systematically tune the molecular weight of poly(3-hexylthiophene-2,5-diyl) (P3HT) from 2 to 30 kDa while maintaining narrow dispersity (PDI< 1.2) through living anionic polymerization. We uncover a non-monotonic, parabolic dependence of on-current, mobility, and conductance retention on molecular weight, with an optimum at ~17 kDa. Correlative microstructural characterization and in-situ Raman spectroscopy attribute these trends to molecular-weight-dependent charge transport and polaron formation. Collectively, these results establish a molecular-level design rule linking polymer chain length to the operation of electrochemical neuromorphic devices, advancing organic neuromorphic platforms toward functional bio-integrated systems.

[Poster 02-21]

Cost-Effective $(Bi,Sb)_2Te_3$ thermoelectric devices with Designed Voids for Co-Optimized Thermal and Electrical properties

Yae Eun Park[a,#], Jae Sung Son[a,*]
[a]Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Gyeongsangbuk-do, 37673, Republic of Korea
Email: sonjs@postech.ac.kr

Keywords: Thermoelectric generator, 3d-printing

Fossil-fuel–driven warming and pollution motivate technologies that harvest waste heat directly. Thermoelectrics (TEs) convert heat to electricity without moving parts, are scalable, and operate silently. Near room temperature, Bi_2Te_3-based compounds remain the workhorse TE materials; however, limited conversion efficiency together with high raw-material and processing costs have constrained widespread deployment. This work proposes and investigates a geometry-centric strategy that complements materials discovery by employing 3D-printed thermoelectric legs with deliberately embedded internal voids. By engineering the leg's thermal and electrical properties, the effective thermal resistance increases, thereby amplifying the temperature difference across the thermoelectric leg under fixed external boundary conditions. Although electrical resistance increased, the larger temperature difference enabled the device to maintain power output even with reduced material usage. Comparative analyses against solid (fully dense) legs clarify the trade-offs between increased ΔT and increased resistive losses. Beyond performance, internal voiding directly improves cost-effectiveness by lowering precious material consumption per watt and shortening sintering times. We anticipate that geometry-engineered TE legs can serve as a practical lever—orthogonal to chemistry—for bringing Bi_2Te_3-class devices closer to application, particularly where manufacturability, and bill-of-materials are decisive. Ultimately, the approach strengthens the prospects for commercial adoption of thermoelectric generators and offers a realistic pathway to lessen reliance on fossil fuels.

[Poster 02-22]

Sequential 3D Printing of Functionally Graded Thermoelectric Materials for Enhanced Energy Conversion

Hyunjin Han[a,#], Seong Eun Yang[a], Jae Sung Son[a,*]
[a]Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), RIST 3-3246, Pohang, Gyeongsangbuk-do 37673., Republic of Korea.
Email: sonjs@postech.ac.kr

Keywords: Thermoelectric generator, 3D printing, FGMs, Energy conversion

Functionally graded materials (FGMs) are heterogeneous systems characterized by spatial variations in dopant distribution and structural composition, allowing their properties to be tailored for specific applications. While 3D printing has become a powerful tool for producing FGMs with complex architectures and precise material distributions, its use has largely been confined to structural components, with limited extension into energy and electronic materials. Thermoelectric power generation offers a promising means of harvesting waste heat, yet the strong temperature dependence of high-efficiency thermoelectric materials poses a major barrier to broader deployment. In this work, we demonstrate a sequential 3D printing strategy for fabricating n-type $Bi_2Te_{2.7}Se_{0.3}$ thermoelectric materials incorporating gradients in both electronic dopants and structural porosity. To enable this process, Na-doped $Bi_2Te_{2.7}Se_{0.3}$ colloidal inks with optimized viscoelastic properties were developed, allowing accurate layer-by-layer deposition with a resolution of 150 μm. The resulting printed structures simultaneously integrated atomic-level doping control with macroscale void engineering. The thermoelectric properties of the fabricated FGMs exhibited peak operating temperatures spanning from room temperature to 450 K, tuned through the imposed dopant concentration gradients. By broadening the effective operating temperature window, the graded thermoelectric materials achieved superior power-generation performance compared to their homogeneous counterparts. Overall, this sequential 3D printing approach provides a scalable, rapid, and cost-effective route to manufacturing functionally graded thermoelectric materials. The ability to design and produce FGMs with engineered electronic and structural gradients highlights the potential of additive manufacturing to advance energy conversion and electronic device technologies.

[Poster 02-23]

Highly Efficient Fully Stretchable OLEDs with MXene Electrodes

Hyun-Wook Kim[a,#], Huanyu Zhou[a], Shin Jung Han[a], Danzhen Zhang[b], Woo Jin Jeong[a], Haomiao Yu[c], Youichi Tsuchiya[d], Bin Hu[e], June Huh[f], Teng Zhang[b], Seungyeon Cho[g], Joo Sung Kim[a], Dong-Hyeok Kim[a], Hyung Joong Yun[h], Jinwoo Park[a], Kyung Yeon Jang[a], Eojin Yoon[a], Amit Kumar Harit[i], Min-Jun Sung[a], Yooseng Ahn[j], Hao Chen[a], Qingsen Zeng[a], Chan-Yul Park[a], Kwan-Nyeong Kim[a], Landep Ayuningtias[k], Hoichang Yang[j], Jong Chan Kim[g], Yun-Hi Kim[k], Han Young Woo[i], Chihaya Adachi[d], Yury Gogotsi[b,*], Tae-Woo Lee[a,*]

[a]Department of Materials Science and Engineering, Seoul National University, Seoul 08826, Republic of Korea

[b]A.J. Drexel Nanomaterials Institute and Department of Materials Science and Engineering, Drexel University, Philadelphia, PA 19104, USA.

[c]Key Laboratory of Luminescence and Optical Information, Ministry of Education, School of Physical Science and Engineering, Beijing Jiaotong University, Beijing 100044, People's Republic of China.

[d]Center for Organic Photonics and Electronics Research (OPERA) and Department of Applied Chemistry, Kyushu University, 744 Motooka, Nishi, Fukuoka 819-0395, Japan.

[e]Department of Materials Science and Engineering, University of Tennessee, Knoxville, TN 37996, USA.

[f]Department of Chemical and Biological Engineering, Korea University, Seoul 02841, Republic of Korea.

[g]Department of Integrated Display Engineering, Yonsei University, Seoul 03722, Republic of Korea.

[h]Research Center for Materials Analysis, Korea Basic Science Institute, Daejeon 34126, Republic of Korea.

[i]Department of Chemistry, Korea University, Seoul 02841, Republic of Korea.

[j]Department of Chemical Engineering, Inha University, Incheon 22212, Republic of Korea.

[k]Department of Chemistry and RIMA, Gyeongsang National University, Jinju 52828, Republic of Korea.

Email: twlees@snu.ac.kr, gogotsi@drexel.edu

Keywords: Fully stretchable OLEDs, MXene-contact stretchable electrodes

Fully stretchable OLEDs are crucial for next-genreation on-skin electronics. However, their practical applications are hindered by limited efficiency. To overcome this challenge, transparent conductive electrodes (TCEs) must simultaneously provide mechanical robustness and efficient charge injection. Herein, we introduce MXene-contact stretchable electrodes (MCSEs) that are fully solution-processable and exhibit excellent mechanical resilience. Robust interfacial hydrogen bonding between MXene nanosheets and silver nanowires (AgNWs), along with a MXene binder bridging the junctions, dramatically enhances carrier mobility from 1.4 to 85.9 $cm^2 V^{-1} s^{-1}$. Furthermore, the MXene overlayer provides wide work function tunability (3.79-5.71 eV), enabling efficient charge injection for both anode and cathode. Integrated into fully stretchable OLEDs, MCSEs achieve record high device efficiency with minimal loss in performance even under 60% strain. This work marks the first demonstration of MXene-based stretchable TCEs in optoelectronic devices and offers new insights for designing high-efficiency, mechanically robust stretchable displays.

[Poster 02-24]

Kinetic Monte Carlo Simulation of Time-of-Flight Photocurrent Transients in Amorphous Organic Semiconductors

Hiroyoshi Naito[a,b,c,#,*], Toshio Asada[a, b]
[a]Osaka Metropolitan University, Osaka, Japan
[b]RIMED, Osaka Metropolitan University, Osaka, Japan
[c]RISA, Ritsumeikan University, Shiga, Japan
Email: h.naito@omu.ac.jp

Keywords: amorphous organic semiconductor, time-of-flight photocurrent transient, multiscale simulation

Multiscale simulations combining quantum chemical calculations, molecular dynamics (MD) simulation, and kinetic Monte Carlo (KMC) simulation have recently been employed to study unique charge localization and charge-carrier transport in amorphous organic semiconductors such as 4,4'-Bis(N-carbazolyl)-1,1'-biphenyl (CBP)[1,2]. To gain deeper insights into charge transport phenomena, direct comparison with experiments is essential[3]. In this work, we calculated time-of-flight (TOF) transient photocurrent waveforms using KMC simulations for thin films of amorphous organic semiconductors and compared the results with experimental TOF measurements.

As a representative case, we constructed amorphous clusters of 4,4',4"-Tris(carbazol-9-yl)triphenylamine (TCTA) comprising 233 molecules based on MD simulations, and performed quantum chemical calculations (M06/6-31G) to evaluate orbital energies, transfer integrals, and density of states (DOS)[4].

The calculated valence-band DOS agreed well with ultraviolet photoelectron spectroscopy (UPS) spectra[5], validating the model and confirming a reliable description of the electronic structure. KMC simulations under periodic boundary conditions with high electric fields yielded TOF transient photocurrent waveforms[4, 6]. The simulated current exhibited nondispersive features, consistent with experimental TOF results[7], although the calculated hole drift mobility was slightly lower.

The simulation results will be used to discuss the localization phenomena in amorphous organic semiconductors and to address the presence or absence of a sharp mobility edge.

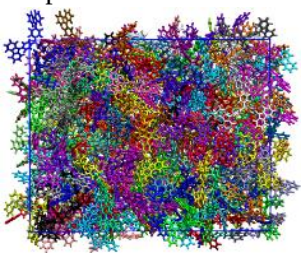


Fig. 1 Amorphous cluster of TCTA.

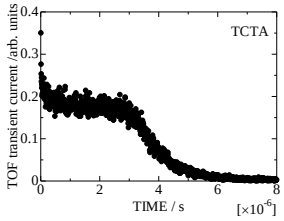


Fig. 3 Simulated TOF transient photocurrent in the TCTA cluster.

[References]

(1) S. Kubo, H. Kaji, *Sci. Rep.* **2018,** *8*, 13462E.

(2) H. Sato, S. Kanda, H. Kaji, *npj Comput. Mater.* **2025**, *11*, 39.

(3) H. Naito, J. Ding, M. Okuda, *Appl. Phys. Lett.* **1994**, *64*, 1830.

(4) T. Asada, S. Koseki, *Org. Electron.* **2018**, *53*, 141.

(5) Y. Zhao, J. Chen, W. Chen, D. Ma. *J. Appl. Phys.* **2012**, *111*, 043716.

(6) N. Ogawa, H. Naito, *Electrical Eng. in Japan* **2002**, *140*, 1.

(7) S. Noh, C. K. Suman, Y. Hong, C. Lee, *J. Appl. Phys.* **2009**, *105*, 033709.

[Poster 02-25]

Study on the Growth Mechanism of Ruddlesden-Popper Phase (RNH3)2Csn-1PbnBr3n+1 Nanoplatelets using Zwitterionic Ligands

Taesun Yun[a,b,#], Dokyum Kim[b], Chi-Ok Hwang[a,*], Chang-Lyoul Lee[b,*]
[a]Department of Physics and Photon Science, Gwangju Institute of Science and Technology (GIST), Gwangju, Korea.
[b]Advanced Photonic Research Institute, Gwangju Institute of Science and Technology (GIST), Gwangju, Korea.
Email: vsepr@gist.ac.kr

Keywords: Ruddlesden-Popper phase, $(RNH_3)_2Cs_{n-1}Pb_nBr_{3n+1}$ nanoplatelets, Zwitterionic ligands

Ruddlesden-Popper (RP) phase halide perovskite nanoplatelets (NPLs) with the general formula $(RNH_3)A_{n-1}B_nX_{3n+1}$, have recently emerged as promising two-dimensional materials for opto-electronic devices. Their layered structure consists of alternating inorganic $[BX_6]^{4-}$ octahedral layers and organic ammonium ligand (spacer ligand) layers. In $(RNH_3)A_{n-1}B_nX_{3n+1}$ structure, a monovalent cation (*e.g.*, $CH_3NH_3^+$, Cs^+) occupies the A-site, a divalent metal cation (*e.g.*, Pb^{2+}, Sn^{2+}) occupies the B-site, a halide anion (Cl^-, Br^-, I^-) occupies the X-site, where *n* denotes the number of octahedral layers in each inorganic layers[1]. The organic ammonium ligand (RNH_3 ligand), containing an amine group, substitutes the A-site cation along the <100> direction of the perovskite lattice.

This layered structure **i**nduces both quantum and dielectric confinement effects due to reduced dimensionality of the PNCs structure and low dielectric constant of the organic spacer ligand, respectively. These combined effects result in wider bandgaps and stronger exciton binding energies in RP NPLs compared to three-dimensional ABX_3 halide perovskite nanocrystals (PNCs). Therefore, pronounced blue-shifted PL emission in RP NPLs makes them promising candidates for the emissive layer in perovskite light-emitting diodes (PeLEDs).[2] However, studies on improving structural stability of NPLs under environmental stress (*e.g.*, moisture, heat, *etc)* and the fundamental mechanism of NPL formation influenced by the type of RNH_3 ligand have not been deeply investigated.

In this study, a zwitterionic ligand with multiple functional groups has been introduced as a surface ligand. In contrast to conventional ligands with dynamic binding, the zwitterionic ligand facilitates stronger and more stable interactions with the surface of NPLs. The concept of ligand–ligand interaction energy (ε_{LL}) was introduced to describe the interaction of zwitterionic ligands along the (100) plane. By systematically controlling the chain length and functionality of zwitterionic ligands, the effects of these parameters on surface bonding and structural stability have been investigated. Our study demonstrates that the environmental stability of NPLs has been dramatically enhanced through surface defect passivation by zwitterionic ligands and provides insights into the crystal growth mechanisms of NPLs.

[References]

(1) Machteld E. Kamminga., Hong-Hua Fang., Marina R. Filip., *et al., Chem. Mater*. **2016**, *28*. 4554-4562.

(2) Chang *et al. Nanoscale Research letters* (**2018**) 13:247.

[Poster 02-26]

Achieving Chirality in Perovskite Nanocrystals by Post-Treatment of Chiral Ligands

Hyomin Park[a,b,#], Dokyum Kim[b], Chi-Ok Hwang[a,*], Chang-Lyoul Lee[b,*]
[a]Department of Physics and Photon Science, Gwangju Institute of Science and Technology (GIST), Gwangju, Korea.
[b]Advanced Photonic Research Institute (APRI), Gwangju Institute of Science and Technology (GIST), Gwangju, Korea.
Email: vsepr@gist.ac.kr

Keywords: Halide perovskite, Chirality, Circular Dichroism (CD), Halide composition

Halide perovskite nanocrystals (PNCs) have emerged as promising materials for various opto-electronic applications due to their excellent optical properties, including high photoluminescence quantum yield (PLQY) and narrow full width at half maximum (FWHM), which contribute to superior color purity. In addition, their optical bandgap can be easily tuned by controlling the halide composition.

Chiral materials exhibit unique optical properties. These include optical activity, which rotates the plane of linearly polarized light, and circular dichroism (CD), which results in differential absorption of left- and right-circularly polarized light. Due to these unique optical properties, chiral materials have attracted considerable attention for a wide range of applications in opto-electronics, asymmetric catalysis, chiral recognition, and three-dimensional (3D) displays. When PNCs acquire chiral properties, the combination of their superior opto-electronic properties with chirality offers unprecedented opportunities for various applications. This enables applications in spintronics and circularly polarized light sources.[2]

Despite the remarkable properties of chiral PNCs, a comprehensive understanding of their chiroptical properties remains limited. In this study, the chirality of PNCs has been investigated by changing the halide composition. Circular dichroism (CD) spectroscopy was employed to examine the effects of halide composition on the chirality and optical activity of PNCs.

[References]

(1) L. Protesescu, S. Yakunin, M. I. Bodnarchuk, F. Krieg, R. Caputo, C. H. Hendon, R. X. Yang, A. Walsh, M. V. Kovalenko, *Nano Lett.* **2015**, *15*, 3692.

(2) Jiang, S.; Song, Y.; Kang, H.; Li, B.; Yang, K.; Xing, G.; Yu, Y.; Li, S.; Zhao, P.; Zhang, T. *ACS Appl. Mater. Interfaces* **2022**, *14*, 3385

[Poster 02-27]

Stretchable High-K Dielectric Metal Oxide Transistor on Polyimide using Azide-functionalized Coordination Ligand

Suryeon JANG[a,#], Jieun KWON[b], Syed Zahid Hassan[b] and Dae Sung Chung[a,b,*]
[a]Pohang university of Science and Technology (POSTECH), Republic of Korea
[b]Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, Gyeongbuk 37673, Republic of Korea
Email: sooryun1129@postech.ac.kr

Keywords: Oxide Transistor, Polymer, Coordination Ligand

The growing demand for stretchable electronics within Internet of Things (IoT) technologies necessitates cost-effective, solution-processed fabrication routes. In this study, we introduce a novel method for fabricating intrinsically stretchable, all-oxide thin-film transistors (TFTs) on a flexible polyimide (PI) substrate. This technique utilizes an organic-inorganic hybrid system composed of metal oxide nanoparticles and custom-synthesized stretchable organic ligands. We developed a series of bidentate ligands featuring azide termini and ethylene-glycol bridges, which impart stretchability and are broadly applicable to various metal oxides. Employing this strategy, we successfully developed a high-quality zirconium dioxide (ZrO2) film as the high-k gate dielectric, crucial for low-power, high-performance circuits. Furthermore, this approach was extended to the semiconductor layer, using indium oxide (In2O3) and zinc oxide (ZnO) to realize fully solution-patterned, all-oxide TFTs directly on the PI substrate. This work fosters the development of high-performance n-type stretchable oxide TFTs with reduced trap density and enhanced charge transport, paving the way for advanced applications in wearable and IoT devices.

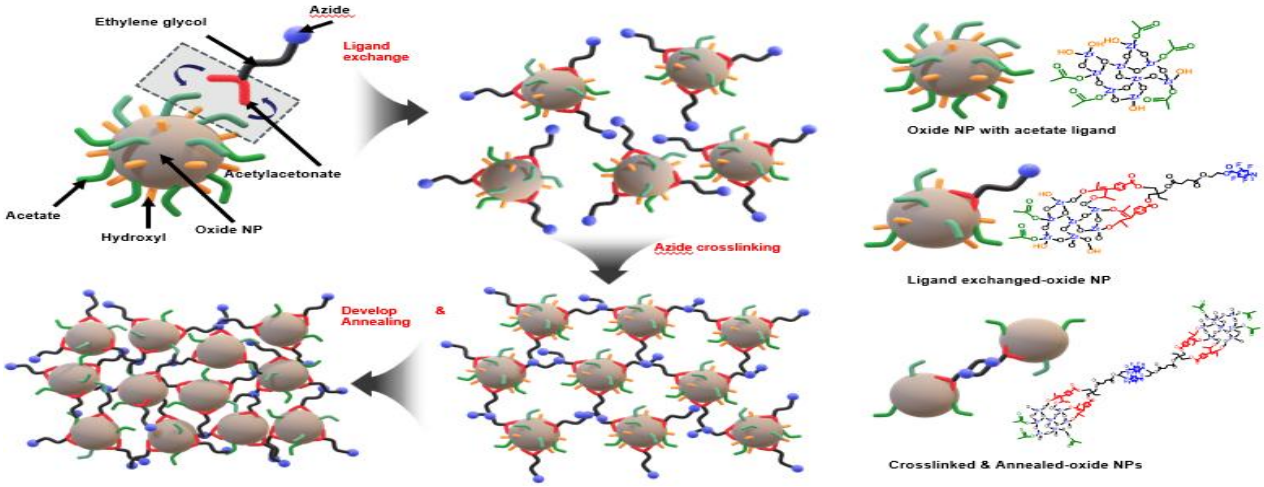


Fig. 1. Proposed structure of oxide NPs with 4-FDA as a crosslinkable ligand.

[References]

(1) Lee, J.; Hassan, S. Z.; Lee, S.; Sim, H. R.; Chung, D. S. *Nat. Commun.* **2022**, *13* (1), 7021

(2) J. Lee, S. Z. Hassan, H. R. Sim, S. Lee, K.-J. Jeong, J. Kwon, C. Y. Son, D. S. Chung, *Adv. Mater.* 2024, **36**, 2409906.

[Poster 02-28]

Red-Emitting CsPb(Br1-xIx)3 Nanocrystals via Thiocyanate-Alkali Metal Doping

Seonjin Lee[a,#], Dokyum Kim[b], Heedae Kim[b,*], Chang-Lyoul Lee[b,*]
[a]Department of Semiconductor & Chemical Engineering (Semiconductor Engineering), Jeonbuk National University, Jeonju, Korea
[b]Advanced Photonic Research Institute (APRI), Gwangju Institute of Science and Technology (GIST), Gwangju, Korea
Email: vsepr@gist.ac.kr

Keywords: Halide perovskite nanocrystals, Thiocyanate-Alkali doping, Red-emission, Stability, Display

Halide perovskite nanocrystals (PNCs) have attracted significant attention as emissive materials for next-generation display due to their high photoluminescence quantum yield (PLQY), narrow emission bandwidth, and tunable bandgap by halide exchange[1]. Due to these superior properties, they are highly promising candidates for various opto-electronic devices.

Red emission is particularly critical **for** full-color display technologies, as it determines color accuracy and enables wide color-gamut coverage, such as **defined by the Rec. 2020 standard.** However, achieving deep red emission **from** $CsPb(Br_{1-x}I_x)_3$ NCs with high PLQY remains highly challenging. A high iodine content, which is essential for narrowing the bandgap and shifting PL emission toward the red region, simultaneously reduces the activation energy for halide ion migration. This facilitates halide ion migration and accelerates phase segregation, resulting in poor structural and optical stability.[1,2] **Accordingly, m**any studies have focused on developing red-emitting $CsPb(Br_{1-x}I_x)_3$ NCs with high structural stability.

In this study, thiocyanate-alkali metal was introduced as a dopant at the A-site and X-site, respectively. The SCN^- ion, which strongly binds with Pb^{2+}, can partially substitute halide ions, thereby suppressing ion migration, reducing defect density, and enhancing the photoluminescence quantum yield (PLQY). Additionally, the effect of alkali metal doping is simultaneously investigated. Through thiocyanate–alkali metal doping, red-emitting $CsPb(Br_{1-x}I_x)_3$ NCs with high structural stability and high PLQY were successfully achieved. This work provides a practical approach to overcoming the intrinsic instability of PNCs and underscores their potential for high-performance display applications.

[References]

(1) B. W. Park, S. I. Seok. *Adv. Mater*. **2019**, *31*, 1805337.

(2) J. M. Azprioz, E. Mosconi, J. Bisquert. F. De Angelis, *Energy Environ. Sci*. **2015**, *8*, 2118.

[Poster 02-29]

Top-Emitting RGB Fluorescent OLEDs with Narrowband Emission for High-Speed Visible Light Communication

Jin Hyup Kim[a,b,#], Kyumi Lee[a,b], Jeong-Hwan Lee[a,b,*]
[a]Inha University, Incheon 22212, Republic of Korea
[b]Progam in Semiconductor Convergence, Incheon 22212, Republic of Korea
Email: Jeong-hwan.lee@inha.ac.kr

Keywords: Visible-light communication, Fluorescent TEOLEDs, Co-emitter architecture

Integrating fluorescent emitters into red, green, and blue organic light-emitting diodes (OLEDs) marks a significant step toward high-speed visible-light communication (VLC). Owing to sub-nanosecond radiative lifetimes, fluorescent emitters enable ultrafast light output essential for rapid data transfer[1]. A top-emitting architecture with a high-Q optical microcavity compresses each channel's spectrum, suppressing RGB spectral crosstalk and expanding usable bandwidth. A co-emitter emissive-layer design further improves optoelectronic performance by promoting in-plane (horizontal) transition-dipole orientation and increasing photoluminescence quantum efficiency[2]. With nanosecond-scale dynamics, the platform preserves clearly resolvable on/off electroluminescence at drive frequencies above 1 MHz, supporting robust high-speed links. Per-color bandwidths surpassing 1 MHz across all RGB channels underscore suitability for future communication hardware. Taken together, these advances highlight fluorescent OLEDs as compelling VLC sources that enable faster data throughput and spur innovation in next-generation optical communication technologies.

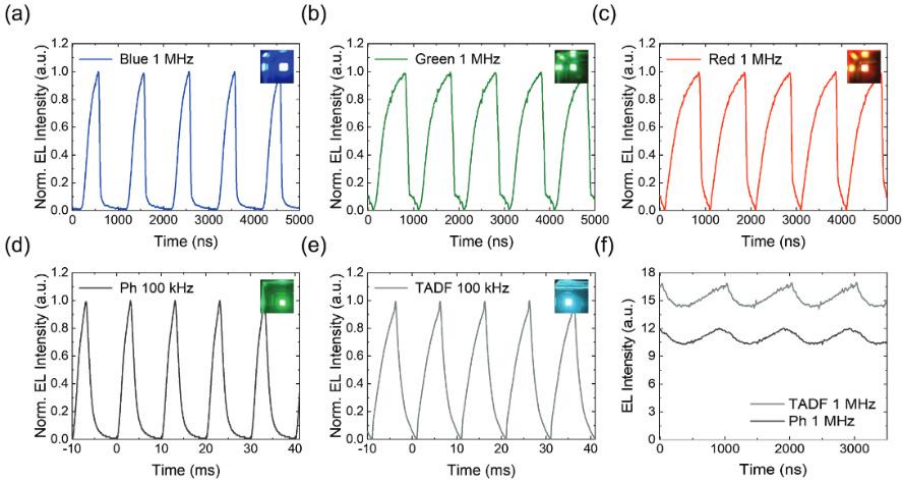


Fig. 1. Tr-EL responses of a) the blue, b) green, and c) red OLEDs under a pulse wave with a repetition frequency of 1 MHz. For comparison, d) phosphorescent and e) TADF OLEDs are indicated under a pulse with a frequency of 100 kHz. Under the 1 MHz operation, the on/off states can hardly be obtained from the f) phosphorescent and g) TADF OLEDs.

[References]

(1) M. N. Munshi, L. Maret, B. Racine, A. P. A. Fischer, M. Chakaroun, N. Loganathan, *IEEE Photonics Technol. Lett.*, **2023**, 35, 1399

(2) D. Kim, H. J. Park, S. H. Jung, W. J. Pyo, S. Z. Hassan, H. R. Sim, J. H. Lee, D. W. Jee, D. S. Chung, *Adv. Mater.*, **2024**, 36, 2309416

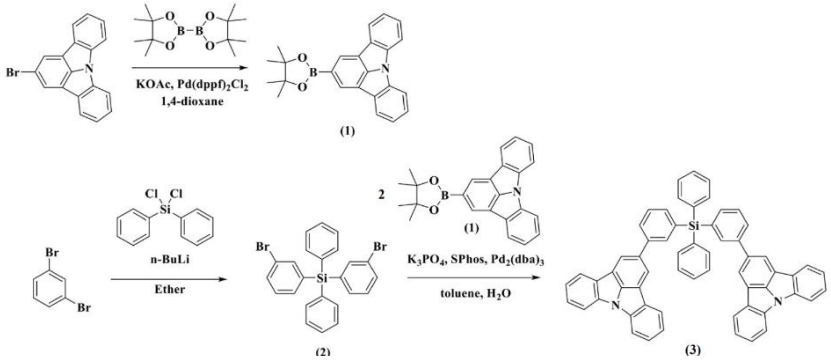
[Poster 02-30]

Developing Synthesis of Silane-Based Host for Blue Phosphorescent OLEDs

Seonjeong Lee[a,#], Yun-Hi Kim[a,*]
[a]Department of Chemistry and RIMA, Gyeongsang National University, Jinju, 52828, Republic of Korea
Email: ykim@gnu.ac.kr

Keywords: Silane-based host material; Si-IDCz; Blue phosphorescent OLEDs; Thermal stability

This research explores the synthesis and properties of a new thermally stable silane-based host material designed for blue phosphorescent organic light-emitting diodes.[1-2] It introduces the development of Si-IDCz, a novel host material, and examines its characteristics. Si-IDCz demonstrates promising features for enhancing the performance of blue phosphorescent OLEDs, particularly in terms of thermal stability. The study sheds light on the potential applications of silane-based materials in OLED technology and their role in improving device efficiency.



Scheme 1. Synthesis of bis[3-(2-indolo[3,2,1-jk]carbazolyl)phenyl)diphenylsilane (Si-IDCz).

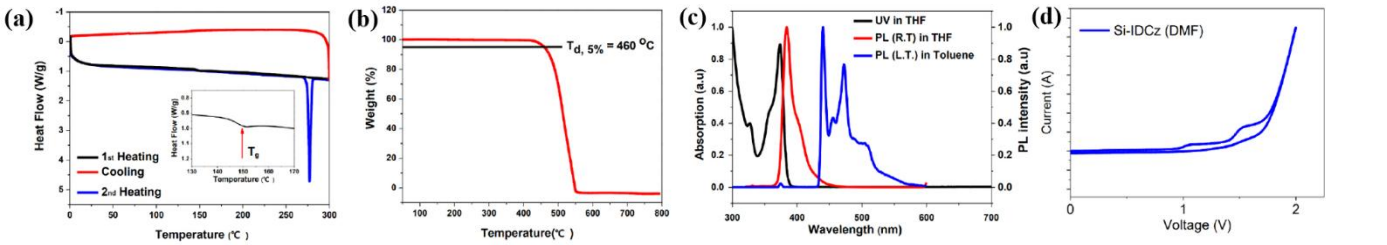


Fig. 1. (a) Differential scanning calorimetry (DSC) data and (b) thermogravimetric analysis (TGA) characteristics of Si-IDCz. (c) Ultraviolet–visible light absorption and photoluminescence (PL) spectra, and (d) cyclic voltammograms characteristics of Si-IDCz.

T_g (°C)	$T_{d,\ 5\%}$ (°C)	UV, λ_{abs} (nm)	L.T PL λ_{em} (nm)	R.T PL λ_{em} (nm)	E_T (eV)	Band gap (eV)	HOMO (eV)	LUMO (eV)
151	460	374	370	439	2.88	3.22	5.43	2.21

Table 1. Thermal and photophysical properties of the Si-IDCz.

[References]

(1) Shih, P.; Chien, C.; Chuang, C.; Shu, C.; Yang, C.; Chen, J.; Chi, Y. *J. Mater. Chem.* **2007**, *17*, 1692

(2) Kang, J.-W.; Lee, D.-S.; Park, H.-D.; Kim, J. W.; Jeong, W.-I.; Park, Y.-S.; Lee, S.-H.; Go, K.; Lee, J.-S.; Kim, J.-J. Org. Electron. **2008**, 9, 452

[Poster 02-31]

Synthesis of Indolocarbazole-Based Hosts with Bipolar Characteristics

Eunju Shin[a,#], Baeksang Sung[b], Chul Woong Joo[c,d], Dasol Kim[b,c], Jinhwa Kim[b], Jonghee Lee[b], Yun-Hi Kim[a,*]
[a]Department of Chemistry and RIMA, Gyeongsang National University, Jinju, 52828, Republic of Korea
[b]Department of Creative Convergence Engineering, Hanbat National University, Daejeon, 34158, Republic of Korea
[c]Reality Device Research Division, Electronics and Telecommunications Research Institute, Daejeon, 34129, Republic of Korea
[d]School of chemical Engineering, Sungkyunkwan University, 2066, Seobu-ro, Jangan-gu, Suwon, Gyeonggi, 16419, Republic of Korea
Email: ykim@gnu.ac.kr

Keywords: Organic light-emitting diode, Roll-off, Host material, Phosphorescent OLED, Bipolar host

Green phosphorescent OLEDs (PhOLEDs) often suffer from efficiency roll-off at high luminance due to charge imbalance and host degradation[1]. To address this, we designed bipolar host materials[2] by fusing a rigid indolocarbazole (ICz) core[3]—with intrinsically high triplet energy and stability—with substituents of tunable donating character: dibenzofuran (DBF) and pyridofuro-pyridine (PFP). The resulting hosts, ICz-DBF and ICz-PFP, were synthesized via Suzuki coupling and exhibit high thermal robustness (T_d = 326 °C and 363 °C) and suitably high triplet energies (E_T = 2.87 and 2.83 eV), ensuring exciton confinement with $Ir(ppy)_2(acac)$ emitters. Devices employing 10 wt% $Ir(ppy)_2(acac)$ in these hosts delivered markedly reduced roll-off compared to a CBP control. Notably, the ICz-DBF device achieved EQE_max = 20.5% and CE_max = 71.6 cd A^{-1}, with a high J at 20% EQE-loss of 0.0095 A cm^{-2} (vs. 0.0011 A cm^{-2} for CBP), indicating stable emission at elevated current density. Although ICz-PFP showed the highest film PLQY (74%), single-carrier analyses revealed excess electron transport and a recombination-zone shift, yielding lower device EQE (14%). These results validate ICz-based bipolar hosts as an effective platform for roll-off suppression and high efficiency in green PhOLEDs, and they provide a clear guideline for balancing charge transport through rational donor-segment selection.

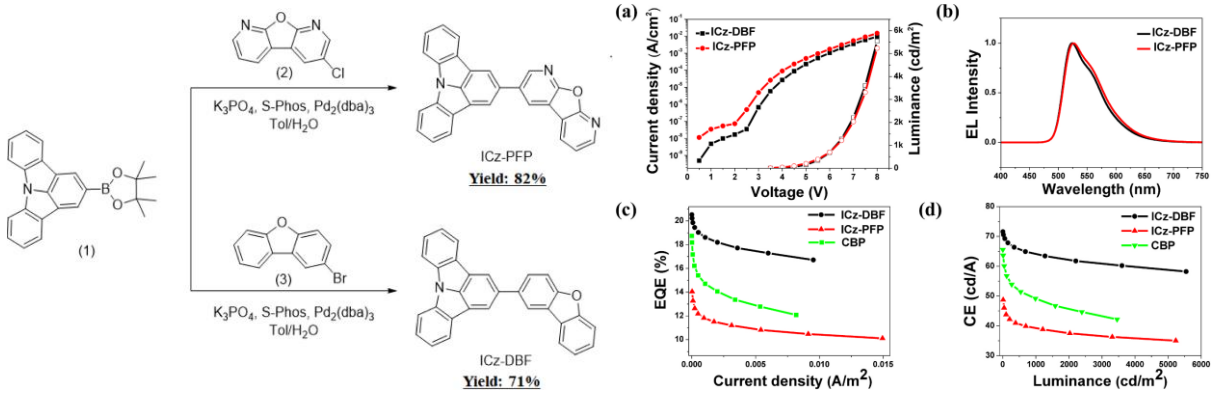


Fig. 1. Synthesis and performance of ICz-based hosts.

[References]

(1) Scholz, S.; Kondakov, D.; Lussem, B.; Leo, K. *Chem. Rev.* **2015**, *115* (16), 8449– 8503

(2) Li, W.; Li, J.; Liu, D.; Jin, Q. *ACS Appl. Mater. Interfaces* **2016**, *8*, 22382– 22391

(3) D. Zhang, X. Song, M. Cai, H. Kaji, L. Duan, *Adv. Mater.* **2018**, *30*, 1705406

[Poster 02-32]

Balanced Molecular Design of Benzoselenadiazole π-Bridges and ICT-Enhanced Terminal Units for Highly Sensitive NIR Organic Photodetectors

Un-Hak Lee[a,#], Se Jeong Park[b], Yeonsu Choi [b], Seo-Jin Ko[a,*]
[a]Department of Energy Science and Engineering, Daegu Gyeongbuk Institute of Science and Technology (DGIST), Daegu 42988, Republic of Korea.
[b]Photoenergy Research Center, Korea Research Institute of Chemical Technology (KRICT), 141 Gajeong-ro, Yuseong-gu, Daejeon 34114, Republic of Korea.
Email: sjko927@dgist.ac.kr

Keywords: Organic photodetectors, non-fullerene acceptors, Near-infrared absorbing materials, benzoselenadiazole, asymmetric structures.

Organic photodetectors (OPDs) operating in the near-infrared (NIR) region are of great interest for applications in imaging, sensing, and communication. Here, we present a molecular design strategy for asymmetric non-fullerene acceptors (NFAs) in which two structural motifs were systematically tuned: (i) replacement of the benzothiadiazole π-bridge with a benzoselenadiazole unit, and (ii) halogen exchange at the terminal acceptor from fluorine to chlorine. UV–vis absorption, cyclic voltammetry, and Raman spectroscopy indicate that the incorporation of selenium extends the conjugation and reduces the optical bandgap, consistent with enhanced π-delocalization. In contrast, Cl-substituted derivatives exhibited narrower bandgaps due to stronger intramolecular charge transfer (ICT), yet also revealed increased film roughness and edge-on molecular orientation, as confirmed by AFM and GIWAXS. Device studies using PCE10 as the donor polymer demonstrate that COS(F) the benzoselenadiazole-based, fluorinated derivative achieves the best balance of optoelectronic properties and morphology. The corresponding OPDs exhibit a responsivity of 0.22 A/W and detectivity of 3.49 × 10^{12} Jones at 1100 nm, with a fast rise/fall response (14.8/16.0 μs). In contrast, Cl-substituted analogues, despite their lowered bandgaps, suffer from reduced mobility and trap-assisted recombination, leading to slower device response and diminished responsivity. These findings highlight the critical interplay between electronic structure and film morphology in low-bandgap NFAs, underscoring that achieving high-performance NIR OPDs requires not only ICT enhancement but also careful control of molecular ordering. Our results provide new insights into the rational design of NFA-based materials for next-generation organic photodetectors.

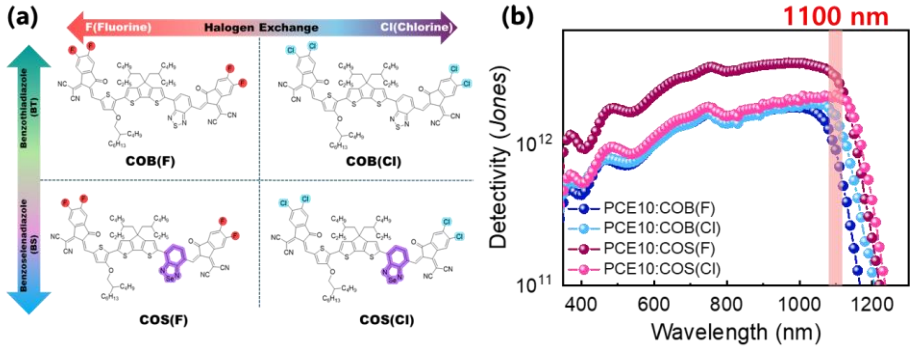


Fig. 1. (a) Chemical structure of electron acceptor COB(F), COB(Cl), COS(F), and COS(Cl) (b) Calculated shot noise based specific detectivity at V= -1.0 V

[References]

(1) U. H. Lee, B. Park, S. Rhee, J. W. Ha, D. R. Whang, H. J. Eun, J. H. Kim, Y. Shim, J. Heo, C. J. Lee, B. J. Kim, S. C. Yoon, J. W. Lee, S. J. Ko, *Adv. Opt. Mater.* **2023**, *11*, 2300312

[Poster 02-33]

Synergistic Alignment of Pt-Based Sensitizer and Thermally Activated Delayed Fluorescence Emitters for High-Performance Phosphor-Sensitized Fluorescent Organic Light-Emitting Diodes

Da-eun Lee[a,b,#], Seung-Hyun Baek[a,b], Yun-Hi Kim[c,*], Jeong-Hwan Lee[a,b,*]
[a]Department of Materials Science and Engineering, Inha University, Incheon 22212, Korea
[b]Pogram in Semiconductor Convergence, Inha University, Incheon 22212, Korea
[c]Department of Chemistry and RINS, Gyeongsang National University, Jinju 52828, Korea
Email: jeong-hwan.lee@inha.ac.kr

Keywords: PSF OLEDs, Blue OLEDs, Emitting dipole orientation(EDO)

Phosphor-sensitized fluorescent (PSF) organic light-emitting diodes (OLEDs) combine high efficiency with sharp spectral control in the blue region.[1] Here, PSF devices were fabricated using a platinum-based phosphorescent sensitizer (Pt-Adaph) and a boron-based multi-resonance (MR) fluorescent emitter (mBP–DABNA–Me), enabling efficient exciton transfer and well-aligned emission. The orbital interaction between the dz^2 electrons of Pt and the vacant pz orbital of boron was found to enhance horizontal emitting dipole orientation (EDO) to 81%, outperforming individual components and thus improving light outcoupling.[2] The optimized devices exhibited a narrow emission spectrum with a full width at half maximum (FWHM) of 29 nm and achieved a peak external quantum efficiency (EQE) of 25%.

The optimized devices exhibited a narrow emission spectrum with a FWHM of 29 nm and achieved a peak EQE of 25%. They also maintained spectral stability under various drive conditions, ensuring excellent color reproducibility. Transient electroluminescence and photoluminescence studies confirmed rapid exciton decay with suppressed delayed contributions, indicating effective mitigation of triplet–triplet annihilation.

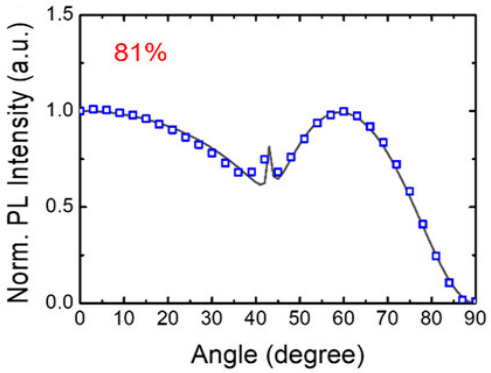


Fig. 1. Angle-dependent photoluminance (ADPL) measurements of PSF (8% Pt-AdaPh:3% mBP–DABNA–Me) using thin films with a host (DPEPO) matrix

[References]

(1) T. Fujii, C. Kon, Y. Motoyama, K. Shimizu, T. Shimayama, T. Yamazaki, T. Kato, S. Sakai, K. Hashikaki, K. Tanaka, Y. Nakano, *J. Soc. Inf. Disp.*, **2018**, *26*, 178.

(2) C. I. Park, M. Seong, M. A. Kim, D. Kim, H. Jung, M. Cho, S. H. Lee, H. Lee, S. Min, J. Kim, M. Kim, J.-H. Park, S. Kwon, B. Kim, S. J. Kim, W. Park, J.-Y. Yang, S. Yoon, I. Kang, *J. Soc. Inf. Disp.*, **2018**, *26*, 287.

[Poster 02-34]

Exciton quenching behaviors in 4CzIPN-based emission layers and their host material dependence studied by DCM-PL technique

Kotaro Kudo[a,#], Yutaka Noguchi[b,*]
[a]Graduate School of Science and Technology, Meiji University, Japan.
[b]School of Science and Technology, Meiji University, Japan.
Email: noguchi@meiji.ac.jp

Keywords: organic light-emitting diode, thermally activated delayed fluorescence, spontaneous orientation polarization, exciton-polaron quenching.

Understanding the interaction between charge carriers and excitons is essential for improving the performance of organic light-emitting diodes (OLEDs)[1,2,3]. We previously proposed displacement current measurement (DCM) combined with photoluminescence (PL) detection (DCM-PL), as a method to investigate exciton-polaron quenching (EPQ) by simultaneously monitoring charge accumulation and exciton behaviors[3]. Applying this technique to Ir-complex based devices, we demonstrated that spontaneous orientation polarization (SOP) can suppress EPQ in the emission layer[3,4]. In this study, we investigate how the host material of a 4CzIPN-based emission layer (EML) influences the dynamics of charge carriers and excitons.

Figure 1(a) shows the device structure and the measurement setup used in the DCM-PL technique. We investigated a metal-insulator-semiconductor (MIS)-type hole-only device incorporating a 4CzIPN-based EML with either a polar (TPBi) or nonpolar (CBP) host (Fig. 1(b)).

Figure 1(c) shows the DCM-PL characteristics of CBP and TPBi-host devices at a sweep rate of 10 V/s. In the CBP-host device, pronounced exciton quenching is observed under both forward and reverse biases, which can be attributed to EPQ (①, bottom panel) and electric-field-induced quenching (②, bottom panel), respectively. In contrast, the TPBi-host device exhibits almost no exciton quenching (bottom panel), despite the hole accumulation behavior (top panel). These results are consistent with the interpretation that the SOP of the host material suppresses exciton quenching.

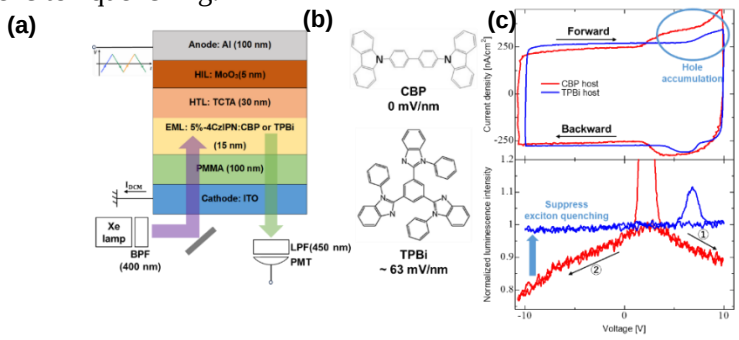


Fig. 1. (a) Schematic of the DCM-PL measurement setup and device structure. (b) Chemical structures of CBP and TPBi. A representative giant surface potential slope of the neat film is also shown. (c) DCM-PL characteristics of the 5%-doped devices with different host materials, measured at a sweep rate of 10 V/s under 400 nm UV.

[References]

(1) J. S. Bangsund et al., *Sci. Adv*. *6*(32), eabb2659 (**2020**).

(2) E. Pakhomenko, S. He, R. J. Holmes, *Chem. Phys. Rev*. *4*, 021308 (**2023**).

(3) Y. Noguchi, K. Ninomiya, K. Sato, *J. Phys. Chem. C 126*, 18520 (**2022**).

(4) S. Nakano, Y. Noguchi, *ACS Appl. Electron. Mater*. *7*, 4182-4190 (**2025**).

[Poster 02-35]

Ultra-Sensitive Short-Wave Infrared Organic Photodetectors Enabled by a π-Conjugation Extended Proquinoid Electron Acceptor

Yeonsu Choi[b,#], Se Jeong Park[b,c], Seunghyun Rhee[b], Bo Ram Lee[c], Sung Cheol Yoon[b], Seo-Jin Ko[a,*]
[a]Department of Energy Science and Engineering, Daegu Gyeongbuk Institute of Science and Technology (DGIST), Daegu 42988, Republic of Korea
[b]Photoenergy Research Center, Korea Research Institute of Chemical Technology (KRICT), 141 Gajeong-ro, Yuseong-gu, Daejeon 34114, Republic of Korea
[c]School of Advanced Materials Science and Engineering, Sungkyunkwan University (SKKU), Suwon 16419, Republic of Korea
Email: sjko927@dgist.ac.kr

Keywords: short-wave infrared region, non-fullerene acceptor, proquinoid, bulk-heterojunction, organic photodetector

Short-wavelength infrared (SWIR) light detection technologies have attracted considerable attention due to their broad applications in bioimaging, sensing, and optical communication. Despite this promise, achieving high-performance organic SWIR photodetectors (SWIR OPDs) remains a major challenge due to intrisically weak photoresponse and sensitivity in this spectral region. Herein, we report a novel proquinoid-type non-fullerene acceptor (NFA), denoted as TQC-4Cl, which exhibits an ultra-narrow band gap of 1.01 eV and a broad spectral response extending beyond 1200 nm, enabled via an aromatic-quinoid transformation strategy. Thermal annealing of the TQC-4Cl film significantly enhanced crystallinity and molecular ordering. Consequently, the optimized TQC-4Cl-based SWIR OPDs exhibit an exceptionally low dark current density (J_d) of 4.38×10^{-8} A cm^{-2}, noise current of 466 fA (at 4 Hz) and a high external quantum efficiency (EQE) of 13.66% at 1200 nm at -0.5 V bias, resulting in a shot-noise limited specific detectivity (D_{sh}*) of 1.06×10^{12} Jones and a noise current-based D* of 2.84×10^{11} Jones under the same bias conditions. The ideal phase-separated morphology and high crystallinity of photoactive layer provide the beneficial condition enabling efficient charge extraction, suppressed bimolecular recombination, and reduced energetic disorder. Furthermore, the devices demonstrated long-term operational stability at 85 ℃, underscoring their superior thermal durability. This study not only marks the advancement toward the realization of highly sensitive and thermally robust SWIR OPDs but also contributes to the rational molecular design strategies for ultra-narrow bandgap organic semiconductors for next-generation optoelectronic devices.

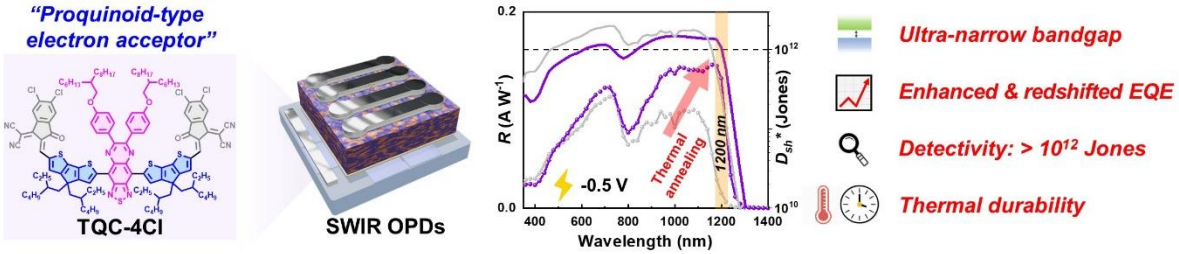


Fig. 1. Research summary for development of highly sensitive SWIR OPDs over 1000 nm based on proquinoid-type NFA

[Poster 02-36]

Polarization-Driven Electron Injection for Enhanced Organic Light Emitting Diode Performance

Amarja Katware[a,#], Jeong-Hwan Lee[a,b,*]
[a]Department of Materials Science and Engineering, Inha University, Incheon 22212, Republic of Korea
[b]Program in Semiconductor Convergence, Inha University, Incheon 22212, Republic of Korea
Email: jeong-hwan.lee@inha.ac.kr

Keywords: electron injection layer, perovskite interlayer, organic light-emitting diode, interface dipole.

Efficient OLED operation depends on balanced charge injection and transport, with the electron-injection playing a key role in efficiency. Conventional electron-injection layers (EILs) such as LiF, Liq, Mg, and Yb lower the cathode barrier but face stability and performance trade-offs[1-3]. To address these limitations, we introduce a vacuum-deposited perovskite interlayer with a large intrinsic polarization that strengthens the interface dipole at the cathode/ETL contact. This dipole-driven barrier lowering enhances electron supply without additional surface treatments or stack redesign. Using a 5-nm perovskite EIL, devices show a 2–4% increase in external quantum efficiency and ~10% higher power efficiency relative to LiF-based controls, while maintaining straightforward multilayer integration. Notably, unlike LiF, the perovskite EIL is compatible with both silver and aluminum electrodes, offering greater flexibility in device design and fabrication. These findings highlight the potential of advanced EILs in optimizing OLED performance for next-generation displays and lighting applications.

[References]

(1) S. J. Ok, T. N. Le, J. H. Son, S. Y. Song, M. C. Suh, *Adv. Optical Mater*, **2025**, *13*, 2402832.

(2) R. Vladoiu, A. Mandes, V. Dinca, M. Tichy, P. Kudrna, C. Ciobotaru, S. Polosan, *Journal of Magnesium and Alloys*, **2024**, *12*, 3115.

(3) Felipe A. Angel, Rui Gao, Jason U. Wallace, Ching W. Tang, *Organic Electronics*, **2018**, *59*, 220.

[Poster 02-37]

The Effects of Methoxy Functionalization of Diketopyrrolopyrrole Based Conjugated Polymers on The Doping and Thermoelectric Properties

Landep Ayuningtias[a,#], Hansol Lee[b], Hoimin Kim[c], Jaehoon Lee[c], Jiyun Lee[c], Min-Jae Kim[c], Dongki Lee[d], Byung Mook Weon[e], Dong-Am Park[f], Nam-Gyu Park[f], Sung Yun Son[g], Junki Kim[ch], Boseok Kang[ch], Yun-Hi Kim[a,*]

[a]Department of Chemistry and Research Institute of Natural Science (RINS), Gyeongsang National University, Jinju, Republic of Korea

[b]Department of Chemical and Biological Engineering, Gachon University, Seongnam, Republic of Korea

[c]SKKU Advanced Institute of Nanotechnology (SAINT) and Department of Nano Science and Technology, Sungkyunkwan University, Suwon, Republic of Korea

[d]Department of Nanotechnology and Advanced Materials Engineering, Sejong University, Seoul, Republic of Korea

[e]School of Advanced Materials Science and Engineering and SKKU Advanced Institute of Nanotechnology (SAINT), Sungkyunkwan University, Suwon, Republic of Korea

[f]School of Chemical Engineering, Center for Antibonding Regulated Crystals and SKKU Institute of Energy Science and Technology (SIEST), Sungkyunkwan University (SKKU), Suwon, Republic of Korea

[g]Department of Chemistry, Kwangwoon University, Seoul, Republic of Korea

[h]Department of Nano Engineering, Sungkyunkwan University, Suwon, Republic of Korea

Email: ykim@gnu.ac.kr

Keywords: conjugated polymers, doping efficiency, methoxy functionalization, molecular doping, organic thermoelectrics.

The introduction of alkoxy side chains into the backbone of conjugated polymers is an effective way to change their properties. Since limited research has been conducted on their effects on doping and thermoelectric properties,[1] thus in this study, the effects of methoxy functionalization of conjugated backbones on the doping and thermoelectric properties are investigated through a comparative study of diketopyrrolopyrrole-based conjugated polymers with and without methoxy groups (P29DPP-BTOM and P29DPP-BT, respectively). It results in methoxy-functionalization significantly enhancing doping efficiency, converting undopable pairs to dopable ones. In addition, the introduction of methoxy groups[2] affected the molecular orientation distribution of the polymer films, which contributed to higher Seebeck coefficients of the the methoxy-functionalized polymer than that of the polymer without methoxy groups for a given electrical conductivity. Consequently, the methoxy-functionalized polymer showed higher optimized thermoelectric performance compared to the non-methoxy-functionalized one. This study demonstrates the impact of methoxy functionalization of a conjugated polymer on doping behavior and thermoelectric properties, providing a guideline for designing high-performance conjugated polymers for thermoelectric applications.

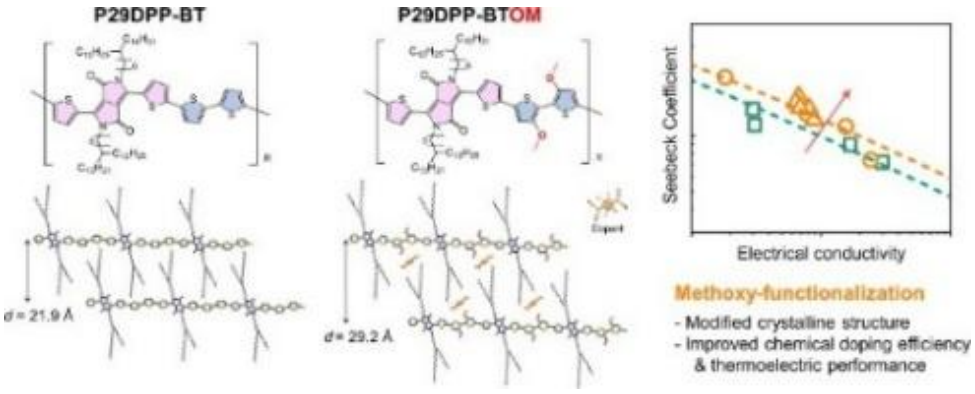


Fig. 1. Graphical Abstract

[References]

(1) Zhao W, Ding J, Zou Y, Di CA, Zhu D. *Chem Soc Rev*. **2020**; 49(20): 7210-7228.

(2) Yang K, Chen Z, Wang Y, Guo X. *Acc Mater Res*. **2023**; 4(3): 237-250.

[Poster 02-38]

Achieving Stable Ambipolar and Unipolar Transport in NDI-DPP-Thiophene Copolymers for Organic Transistors

Karina Ayu Larasati[a,#], Dongyoon Khim[b], Walid Boukhili[b], Chee Leong Tan[b], Huabin Sun[b], Yong-Young Noh,[c,*] and Yun-Hi Kim[a,*]
[a]Department of Chemistry and RIMA, Gyeongsang National University, Jinju 52828, Republic of Korea.
[b]College of Integrated Circuit Science and Engineering, Nanjing University of Posts and Telecommunications, Nanjing 210023, China.
[c]Department of Chemical Engineering, Pohang University of Science and Technology, 77 Cheongam-Ro, Nam-Gu, Pohang 37673, Republic of Korea.
Email: ykim@gnu.ac.kr

Keywords: charge transport, copolymer, differential pulse voltammetry, polarity, thin films**.**

Donor–acceptor (D–A) conjugated copolymers are promising for organic field-effect transistors (OFETs) because of their tunable charge transport. We designed new copolymers combining naphthalenediimide (NDI, strong acceptor), diketopyrrolopyrrole (DPP, weak donor/acceptor), and thiophene (strong donor). By adjusting the NDI:DPP:thiophene ratio, charge polarity was systematically modulated from hole-dominated unipolar to ambipolar and electron-dominated unipolar transport[1]. At extreme ratios (1:9 and 9:1), minority carriers were strongly suppressed, resulting in nearly ideal unipolar performance. This is attributed to distinct molecular orientations—edge-on for DPP (hole transport) and face-on for NDI (electron transport)—which hinder minority pathways, while small fractions of donor/acceptor units may act as traps. Unlike typical low-band-gap ambipolar polymers, these copolymers maintain excellent stability under repeated bias cycling. Structural and morphological studies (DFT, AFM, GIXRD) confirmed the origins of transport modulation. Furthermore, stable n-channel OFETs were fabricated using non-chlorinated solvents, highlighting their potential for sustainable organic electronics.

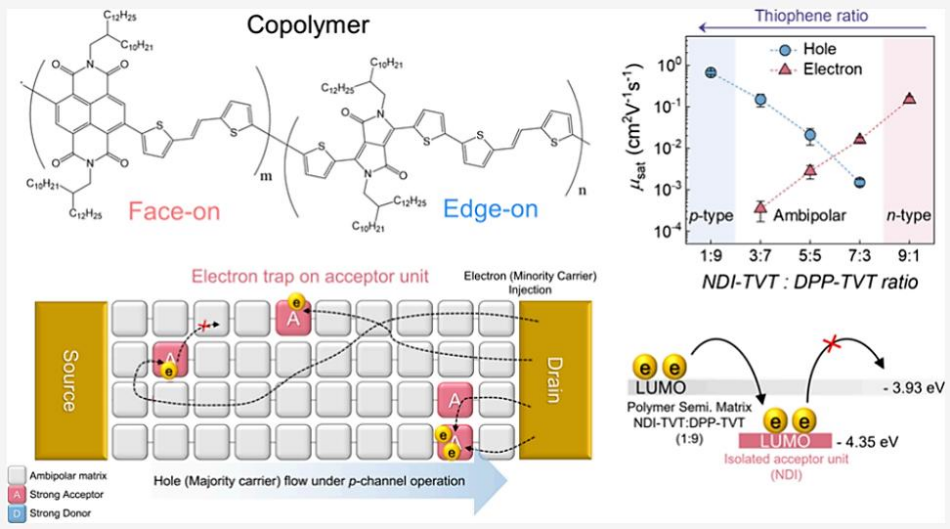


Fig. 1. Copolymer composition and molecular orientation modulate charge polarity.

[References]

(1) Khim, D.; Cheon, Y. R.; Xu, Y.; Park, W.-T.; Kwon, S.-K.; Noh, Y.-Y.; Kim, Y.-H. Chem. Mater. **2016**, *28*, 2287– 2294

[Poster 02-39]

Engineering Conformational Degrees of Freedom of Semiconducting Polymers in Solutions toward Controllable Liquid-Phase Molecular Assembly

Keng-Cheng Wan[a], Cheng-Tai He[a], Chia-Wei Hsu[a], Yu-Han Huang[a], Yun-Hsuan Chiu[a], Yu-Ching Huang[b], and Ben Bang-Yu Hsu[a,#,*]
[a]Department of Materials Science and Engineering, National Cheng Kung University, Tainan, Taiwan.
[b]Department of Materials Engineering, Ming Chi University of Technology, New Taipei City, Taiwan.
Email: hsubon@mail.ncku.edu.tw

Keywords: semiconducting polymers, solution processing, degrees of freedom, solubility, assembly

Solution-processed semiconducting polymeric thin films need kinetically controllable conformations to enhance their processability for wide ranges of molecular weights and solubilities. However, long polymer chains in solutions with random coiling and aggregating typically lead to disorders in processed films. Here, we present novel kinetic engineering that integrates solvatochromic and entropic modulations to more quantitatively control the dimensional and conformational transitions of polymeric nanoaggregates from 2D, folded, 20~140 nm aggregates at low temperature to quasi-3D, unfolded, 1~5 nm bundles at high temperature. Conventional solution processing parameters such as solubility, molecular weight, and the newly introduced conformational degree of freedom are intimately correlated at molecular level.[1,2] Precisely tuning chain kinetic behaviors allows molecular-level control over assembly across multiple phases from precipitation, nucleation to deposition. Our works reveal a promising approach for controllable assembly toward large-scale, highly ordered molecular stacking, and high-performance organic electronics.

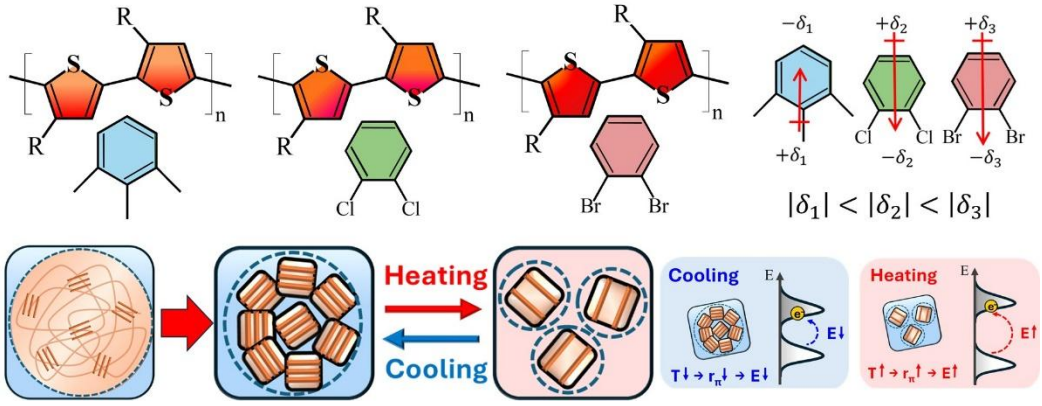


Fig. 1. Solvatochromic indicator reveals the conformational and dimensional transitions of semiconducting polymers in solutions, providing more quantitative control over chain conformations through multiple phase transitions in processing.

[References]

(1) M. N. Pham, C.-J. Su, Y.-C. Huang, K.-T. Lin, T.-Y. Huang, Y.-Y. Lai, C.-A. Wang, Y.-K. Liaw, T.-H. Lin, K.-C. Wan, *Macromolecules* **2024**, *57*, 3544

(2) Chiu, Y. H., Huang, T. Y., Lin, K. T., Wan, K. C., Huang, Y. H., Yang, Y. P., He, C. T., Wei, H. Y., Hsu, T. C., Su, C. J., Wang, C. A., Huang, Y. C., Ruan, J., Jeng, U. S. & Hsu, B. B. Y., *MRS Communications* **2024**, *14*, 1395.

[Poster 02-40]

DCM-EL study of relaxation processes in polyfluorene-derivative-based light-emitting electrochemical cells

Ryota Takubo[a,#], Yutaka Noguchi[a,*]
[a]Graduate School of Science & Technology, Meiji University, Kawasaki 214-8571, Japan.
Email: noguchi@meiji.ac.jp

Keywords: light-emitting electrochemical cell, displacement current measurement, electrochemical doping

Light-emitting electrochemical cells (LECs) are solution processable single-layer devices with an active layer composed of organic semiconductors and electrolytes. Because of their compatibility with flexible electronics, LECs have attracted considerable attention as alternatives to organic light-emitting diodes. However, despite their simple device structure, LECs exhibit complex device characteristics arising from dynamic interactions between mobile ions and injected carriers. To investigate the operation mechanism of LECs, we previously proposed the displacement current measurement combined with electroluminescence detection (DCM-EL)[1]. Applying DCM-EL to the analysis of super yellow (SY)-based LECs, we have revealed the bulk-to-interface relaxation processes of the electrochemical doping and their impact on the luminous efficiency[2]. In this work, we investigated the device characteristics of a highly efficient blue LEC consisting of a blend of the light-emitting polymer F8-Spiro, and the ionic liquid P_{4444}-DBP[3].

The device structure and DCM-EL setup are shown in Fig. 1a. In DCM-EL, a successive triangular wave voltage followed by a constant DC bias is applied, and the current and EL intensity during relaxation processes of electrochemical doping are measured.

Figure 1b shows the actual current (i_{act}, left), displacement current (i_{dis}, middle), and EL efficiency (η, right) obtained by the DCM-EL characteristics. As the number of cycles increased, i_{act} gradually decayed, while i_{dis} exhibited only minor changes. η decreased together with i_{act} along an invariant η-i_{act} curve. These results suggest that the exciton-polaron quenching and self-absorption due to the electrochemical doping in the bulk region did not significantly contribute to efficiency loss in contrast to the case of SY-based LECs[1,2]. At the conference, we will also present further analyses on the dependence of device characteristics on ionic content.

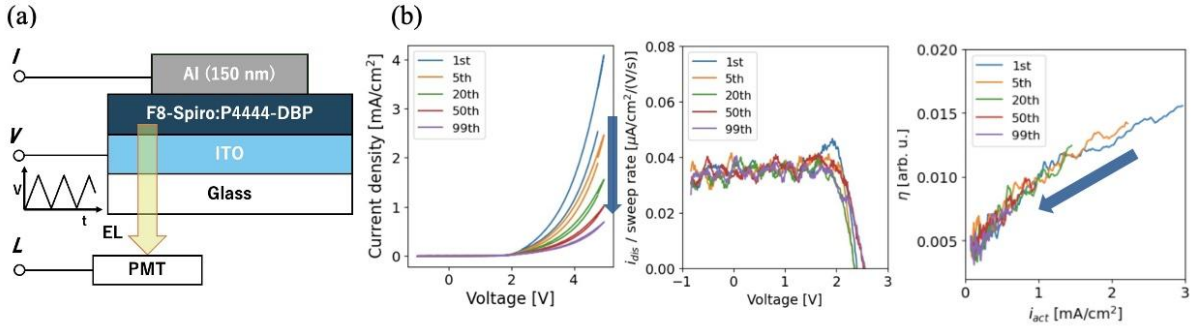


Fig. 1. (a) DCM-EL measurement setup and device structure. The blend ratio of F8-Spiro and P_{4444}-DBP is 6:1, and the active layer thickness is approximately 107.4 nm. (b) DCM-EL characteristics (left: actual current, middle: displacement current, right: EL efficiency). A constant voltage of 4.8 V was applied prior to 100 cycles of triangular wave voltage at a sweep rate of 100 V/s.

[References]

(1). Y. Noguchi, T. Higeta, F. Yonekawa, *Adv. Opt Mater*. **2018**, *6*, 1800318.

(2). H. Iwakiri, H. Watanabe, Y. Noguchi, *ACS Appl. Electron. Mater*. **2021**, *3*, 2355–2361.

(3). T Sakanoue, F Yonekawa, K Albrecht, K Yamamoto, T Takenobu, *Chemistry of Materials*, **2017**, *29*(14), 6122-6129.

[Poster 02-41]

Comparative study on conjugated additives for efficient and stable perovskite solar cells

Haicheng Xi[a,b], Xiangrui Du[a], Zhiqi Yao[a,b], Tianzhuo Li[a,b], Fuqiang Li[a] , and Sung Heum Park[a,b*]
[a]Department of Physics, Pukyong National University, Busan 48513, Republic of Korea.
[b]Institute of Energy Transport and Fusion Research, Pukyong National University, Busan 48513, Republic of Korea
Email: spark@pknu.ac.kr

Keywords: perovskite solar cells, conjugated additives, defect passivation, molecular design, long-term stability.

In this work, we propose a molecular-structure–based additive engineering strategy to simultaneously enhance efficiency and stability in perovskite solar cells (PSCs). We systematically compare a π-conjugated additive, 4-aminobenzylphosphonic acid (4-ABzPA), with a non-conjugated counterpart, 2-aminoethylphosphonic acid (2-AEPA), focusing on their roles in defect passivation, crystallization control, and energy level alignment. The delocalized electronic structure of 4-ABzPA enables stronger coupling with Pb^{2+} sites and halide vacancies, effectively reducing trap densities, improving film morphology, and facilitating charge transport. Devices incorporating 4-ABzPA achieved a champion power conversion efficiency (PCE) of 24.01% and demonstrated superior long-term operational stability under various conditions.

Beyond simply reporting performance, we analyze structure–property relationships and discuss design principles for future additive molecules. In light of current trends, our work aligns with the growing emphasis on multifunctional additives and interface engineering as critical levers to push PSC performance further (such as interfacial dipole effects, strong Lewis base passivators)[1-2] Looking ahead, combining additive molecular design with machine learning screening (such as the recently developed Co-PAS framework)[3] and interface tailoring strategies (such as phosphonic acid–substrate interactions)[4] has the potential to accelerate discovery of next-generation additives. Overall, our study offers both a high-performance additive candidate and a design roadmap for more robust and efficient perovskite photovoltaics.

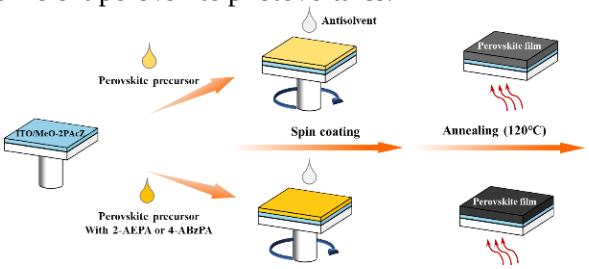


Fig. 1. Perovskite film preparation schematic diagram.

[References]

(1) G. Xu, I. Muhammad, D. Khan, X. Zheng, Y. Zhang, M. Xin, H. Gao, J. Li, J. Wang, D. Lu, *Chem. Eng. J.* **2025**, 511, 161865.

(2) J. Chen, J. Du, J. Cai, B. Ouyang, Z. Li, X. Wu, C. Tian, A. Sun, R. Zhuang, X. Wu, *ACS Energy Lett.* **2025**, 10, 1117.

(3) Y. Pu, Z. Dai, Y. Zhou, N. Jia, H. Wang, Y. Mukhametkarimov, R. Chen, H. Wang, Z. Liu, *Adv. Funct. Mater.* **2025**, e06672.

(4) Q. Tan, H. Wang, S. Tang, Q. Cai, G. Ma, L. Li, J. Guo, G. Xing, C. Chen, M. Cheng, *Adv. Funct. Mater.* **2025**, 2501147.

[Poster 02-42]

Phenothiazine-based self assembled monolayers for systematically modulating interfacial dipole moments in perovskite solar cells

Eunhye Yang[a,b,#], Seungju Kim[c], Pesi Mwitumwa Hangoma[a,b], Kyu Cheol Lee[c,*], Sung Heum Park[a, b,*]
[a]Department of Physics, Pukyong National University, Busan 48513, Republic of Korea.
[b]Institute of Energy Transport and Fusion Research, Pukyong National University, Busan 48513, Republic of Korea
[c]Department of Applied Chemistry, Dong-Eui University, 176 Eomgwangro, Busan, 47340, Korea.
Email: kclee@deu.ac.kr and spark@pknu.ac.kr

Keywords: Self-assembled monolayer (SAM), Hole transport layer (HTL), Interfacial energy alignment, Dipole moment, Perovskite solar cell

Self-assembled monolayers (SAMs) are promising interfacial layers in perovskite solar cells due to their simple processing and tunable properties. In this work, three phenothiazine-based SAMs—PTZ3PA, SPTZ3PA, and Br-SPTZ3PA—were designed with sulfone and bromine substituents to systematically modulate interfacial dipole moments and the work function (WF) of ITO. The WF of ITO modified with PTZ3PA, SPTZ3PA, and Br-SPTZ3PA were −5.11, −5.52, and −5.87 eV, corresponding to shifts of +0.41, +0.82, and +1.17 eV relative to bare ITO. The best device performance was obtained with PTZ3PA, which enabled the formation of uniform perovskite films with larger grain size and efficient charge extraction, resulting in a PCE of 20.18%. In contrast, SPTZ3PA and Br-SPTZ3PA, despite exhibiting stronger dipole moments and larger WF shifts, showed much lower efficiencies of 7.97% and 10.78%, respectively, due to increased leakage currents, poor film formation, and recombination losses. These results suggest that increasing the dipole moment alone is insufficient to enhance device performance. These findings highlight the essential function of dipole moment engineering through SAM molecular design in modifying the interfacial characteristics and offer significant insights for the advancement of effective HTL materials in perovskite photovoltaics.

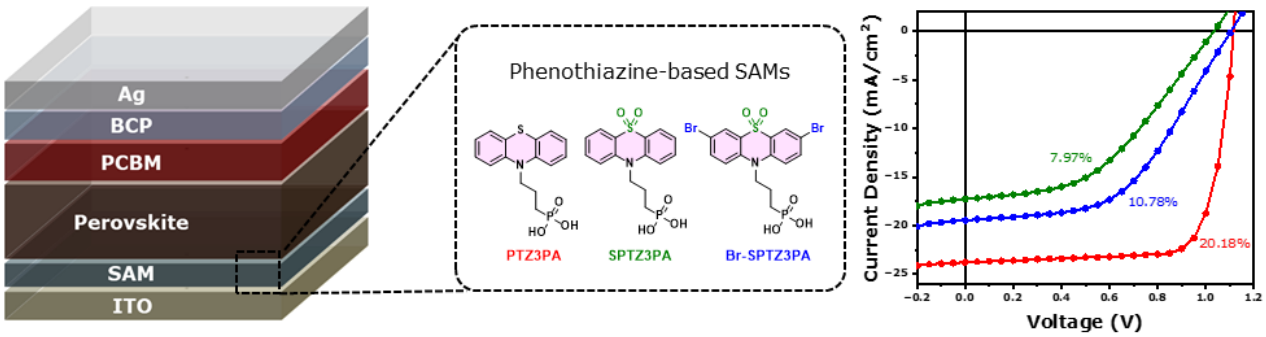


Fig. 1. Schematic diagram of perovskite solar cell device structure including phenothiazine-based SAMs with molecular structures of PTZ3PA SPTZ3PA and Br-SPTZ3PA and J-V curves.

[References]

(1) M. J. Lee, J. S. Park, T. H. Kim, M. A. Saeed, G. M. Lee, J. W. Shim, *Chem. Eng. J.*, **2024**, *481*, 148481.

(2) L. Huang, L. Chen, P. Huang, F. Wu, L. Tan, S. Xiao, W. Zhong, L. Sun, Y. Chen, *Adv. Mater.*, **2016**, *28*, 4852–4860.

(3) Bi, C.; Wang, Q.; Shao, Y.; Yuan, Y.; Xiao, Z.; Huang, J. *Nat. Commun*. **2015**, *6*, 7747.

(4) B. Roose, K. Dey, Y. H. Chiang, R. H. Friend, S. D. Stranks, *J. Phys. Chem. Lett.*, **2020**, *11*, 6505–6512.

[Poster 02-43]

Impact of Charge Accumulation on Device Degradation in Organic Solar Cells Studied by Displacement Current Measurement

Yuki Miyazawa[a,#], Yutaka Noguchi[a,*]
[a]Graduate School of Science & Technology, Meiji University, Kawasaki 214-8571, Japan.
Email: noguchi@meiji.ac.jp

Keywords: organic solar cell, charge accumulation, displacement current measurement, degradation

Charge accumulation in organic solar cells deteriorates power conversion efficiency (PCE) by hindering charge extraction and inducing exciton loss processes[1]. A deeper understanding of these mechanisms is essential for improving both efficiency and stability. Displacement current measurement (DCM), where a triangular wave voltage is applied to the device and response current is measured, is a powerful tool to investigate the correlations between charge accumulation and device performance based on observation of both displacement and actual current[2]

In this study, we applied DCM to examine the impact of charge accumulation on device degradation in a typical bulk heterojunction organic solar cell with a P3HT:PCBM (1:1) active layer (Fig. 1a). Figure 1b shows the device characteristics derived from DCM data measured under 1 sun illumination at a sweep rate of 500 V/s. Device degradation was defined as the decrease in PCE relative to that of the pristine device.

With device degradation, the actual current exhibits a pronounced S-shaped curve (Fig.1b, top left), and the differential conductance near the open circuit voltage decreases (Fig.1b, bottom left). Simultaneously, the accumulated charge density increases (Fig.1b, top right), while the device response rate, estimated as the ratio of differential conductance to capacitance, declines (Fig. 1b, bottom right). These observations suggest deterioration of charge extraction efficiency, leading to enhanced accumulation of the photogenerated charges in the degraded device.

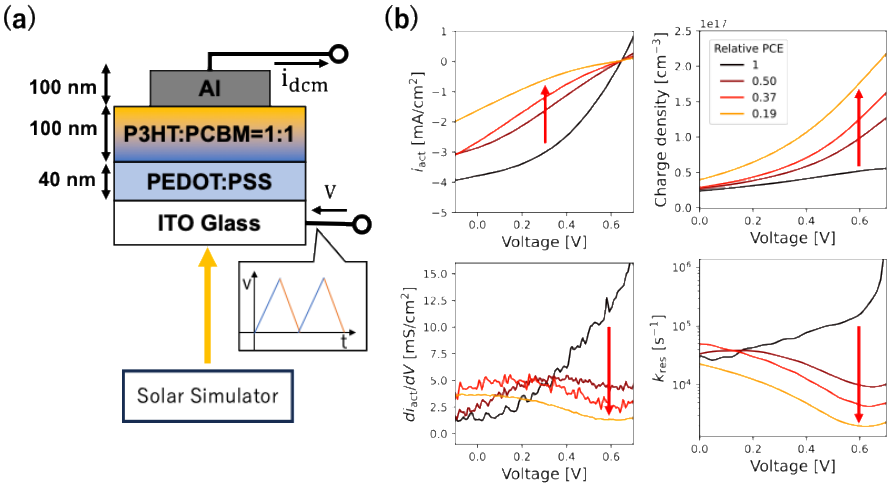


Fig. 1. (a)Schematic of device structure and experimental setup for DCM. (b) Actual current density (top left), accumulated charge density (top right), differential conductance (bottom left) and response rate (bottom right) characteristics derived from the DCM data measured under 1 sun illumination during device degradation.

[References]

(1) J. M. Hodgkiss, et al., *Adv. Funct. Mater*. *22*, 1567 (**2012**)

(2) Y. Noguchi, K. Ninomiya, and K. Sato, *J. Phys. Chem. C 126*, 18520 (**2022**)

[Poster 02-44]

Fully Automated OLED Fabrication: A New Standard for Process Consistency

Seungchan Ham[a,b, #], Jeong-Hwan Lee[a,b,*]
[a]Department of Materials Science and Engineering, Inha University, Republic of Korea
[b]Program in Semiconductor Convergence, Inha University, Republic of Korea
Email: Jeong-hwan.lee@inha.ac.kr

Keywords: OLEDs, Solution-processed OLEDs, Automated OLED fabrication system, Real-time monitoring

Solution-processed OLEDs are highly promising for large-area, low-cost device fabrication, but their complex, multi-step processes often suffer from poor reproducibility and yield due to numerous uncontrolled variables[1, 2]. These inconsistencies hinder reliable characterization and limit the interpretability of experimental results[3]. In this study, we introduce a fully automated OLED fabrication system designed to overcome such challenges by integrating precision robotics with real-time monitoring. The system enables tight control over key parameters such as film thickness, uniformity, and deposition conditions across multiple layers. This level of control not only improves consistency and device reliability but also enhances the reproducibility of optoelectrical measurements. Furthermore, automation significantly reduces labor intensity, increases throughput, and supports cost-effective scaling. Overall, this approach lays a robust foundation for the industrialization of emerging display technologies, including OLEDs, perovskites, and quantum dots, by ensuring stable, scalable, and high-performance device production.

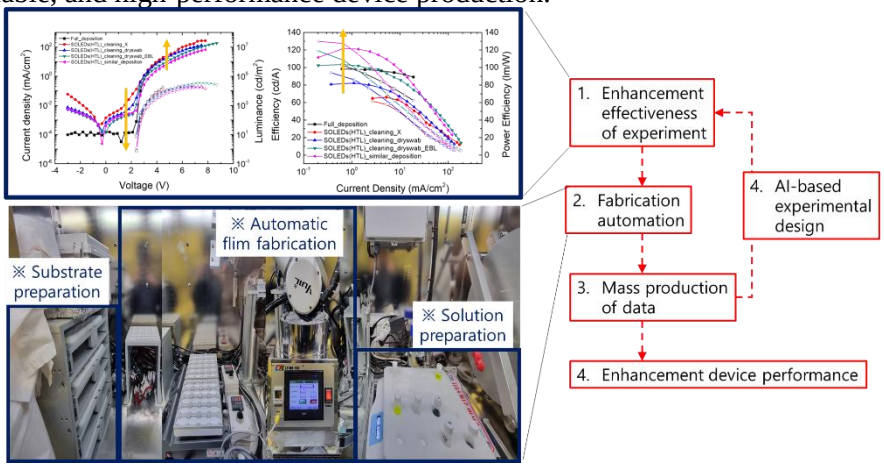


Fig 1. Automatic Device Fabrication System

[References]

(1) J.H. Jou, S. Sahoo, D.K Dubey, R.A.K. Yadav, S.S. Swayamprabha, & S.D. Chavhan, *J. Mater. Chem.* **2018**, C, 6, 11492.

(2) Y. Bonnassieux, C.J. Brabec, Y. Cao, T.B. Carmichael, M.L. Chabinyc, K.T. Cheng, G. Cho, A. Chung, C.L. Cobb, & A. Distler, *Flex. Print. Electron*, **2021**, 6, 023001.

(3) V. Bhat, C.P. Callaway, & C. Risko, *Chem. Rev*, **2023**, 123, 7498.

[Poster 02-45]

Aggregation optimization by molecular engineering of D18-based terpolymer for highly-efficient indoor organic solar cells

Se Jeong Park[a,b,#], Meng Qiang Li[c,#], Seo-Jin Ko[d,*]
[a]School of Advanced Materials Science and Engineering, Sungkyunkwan University (SKKU), Suwon, 16419, Republic of Korea
[b]Korea Research Institute of Chemical Technology (KRICT), Daejeon 34114, Republic of Korea
[c]Department of Chemical Engineering and Applied Chemistry, Chungnam National University, Daejeon 34134, Republic of Korea
[d]Daegu Gyeongbuk Institute of Science and Technology (DGIST), Daegu, 42988, Republic of Korea
Email: sjko927@dgist.ac.kr

Keywords: Indoor organic solar cells, microelectronics, wide band gap, fused ring, aggregation.

Controlling aggregation and phase separation is crucial for achieving efficient indoor organic solar cells (IOSCs) that harvest ambient light to power low-energy electronics. We synthesized D18BTST terpolymers by partially replacing the D18 backbone with a rigid π-bridge to optimize morphology. The D18BTST$_{0.4}$:FCC-Cl device achieved 22.41% indoor efficiency with a J_{sc} of 226.19 μA cm^{-2} and V_{oc} of 0.98 V under 2700 K, 2000 lux, surpassing D18:FCC-Cl (iPCE 18.02%). This strategy highlights a rational molecular design for enhanced morphology and charge transport in IOSCs.

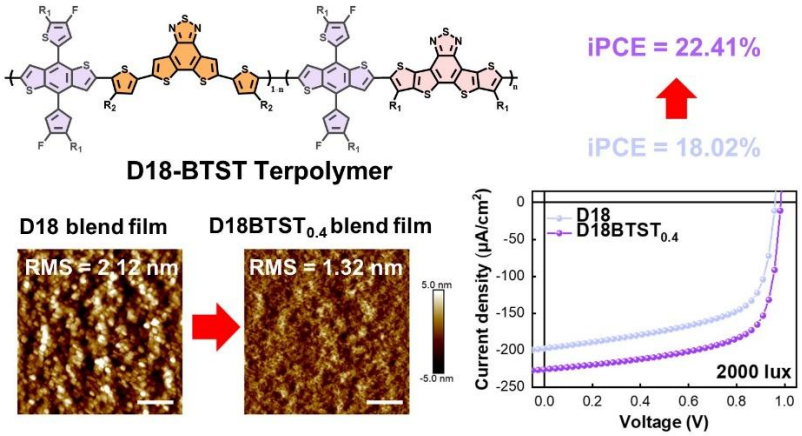


Fig. 1. Enhanced morphology and indoor efficiency of D18BTST$_{0.4}$ terpolymer compared to D18.

[Poster 02-46]

Crystallinity Engineering through Co-Additives for Improved Charge Transport and Optoelectronic Properties in Lead-Tin Perovskite

Junpyo Lee[a], Hyunmin Choi[a], Jaeyoon Cho[a], Jungyoon Choi[a], Yongjin Kim[a], Keehoon Kang[a,*]
[a]Department of Materials Science and Engineering, Research Institute of Advanced Materials, Seoul National University, Seoul, 08826, Republic of Korea

Keywords: Lead-tin mixed perovskite, co-additive, crystal structure, charge transport, optoelectronic

Halide perovskites have attracted significant attention in next-generation charge transport and optoelectronic applications due to their excellent properties, including high carrier mobility and defect tolerance. However, the utilization of lead-based perovskites is restricted by their relatively low mobility and toxicity issues, while tin-based counterparts face stability challenges. Consequently, mixed lead-tin perovskites, which can combine the optimal features of both lead-based and tin-based perovskite, have emerged as a promising alternative. They simultaneously offer high carrier mobility and enhanced stability[(1)], with the additional advantage of a low bandgap[(2)]. Nevertheless, the fabrication of high-quality, high-mobility films of lead-tin perovskite remains challenging, primarily due to the kinetic disparities between the two materials[(3)], as well as persistent oxidation[(4)], which together result in non-uniform crystallization, phase segregation, and trap-assisted recombination.

Herein, we employ a co-additive strategy using organic halide additives, with the function of regulating crystallization dynamics and suppressing oxidation, into mixed lead-tin perovskite and demonstrate the resulting enhancement in charge transport and optoelectronic properties driven by the modified crystal structure. This approach highlights the potential of co-additive engineering to overcome intrinsic limitations of mixed lead-tin systems and provides a feasible pathway toward realizing stable and high-performance perovskite devices.

[References]

(1) Senanayak, S. P.; Dey, K.; Shivanna, R.; Li, W.; Ghosh, D.; Zhang, Y.; Roose, B.; Zelewski, S. J.; Andaji-Garmaroudi, Z.; Wood, W., et al. *Nat. Mater.* **2023**, *22* (2), 216– 224

(2) Goyal, A.; McKechnie, S.; Pashov, D.; Tumas, W.; Van Schilfgaarde, M.; Stevanović, V. *Chem. Mater.* **2018**, *30* (11), 3920– 3928

(3) Z. Wang, X. Duan, J. Zhang, W. Yuan, D. Qu, Y. Chen, L. He, H. Wang, G. Yang, W. Zhang, Y. Bai, H. M. Cheng, *Commun. Mater.* **2024**, *5*, 131

(4) L. Lanzetta, T. Webb, N. Zibouche, X. Liang, D. Ding, G. Min, R. J. E. Westbrook, B. Gaggio, T. J. Macdonald, M. S. Islam, S. A. Haque, *Nat. Commun.* **2021**, *12*, 2853

[Poster 02-47]

Electrochemical Doping in Perovskites for Reconfigurable Photodiodes

Yongjin Kim[a,#], Dohyun Kim[a], Michael Staines[b], Vikram[b], Jimmy Xu[c], Joon-Kyu Han[a], Saiful Islam[b], and Keehoon Kang[a,*],
[a]Department of Materials Science and Engineering, Seoul National University, Seoul, Korea
[b]Department of Materials, University of Oxford, Oxford, United Kingdom
[c]School of Engineering, Brown University, Providence, United States of America
Email: keehoon.kang@snu.ac.kr

Keywords: Metal halide perovskites, Electrochemical doping, Ion migration, Photodiodes, In-sensor computing

Metal halide perovskites exhibit significant doping challenges owing to their soft ionic lattice and susceptibility to structural instability[1,2]. Here, we report an electrochemical doping method that enables controlled incorporation of external ions into the perovskite lattice while preserving its crystal structure and achieving precise doping concentration control. This method was applied to fabricate perovskite-based reconfigurable photodiodes, where modulation of mobile ionic species density allows dynamic tuning of the internal electric field under bias. The devices show reversibly controllable rectification characteristics and photoresponsivity. Our results validate electrochemical doping as an effective strategy to overcome conventional doping limitations in perovskites, offering promising implications for in-sensor computing devices.

[References]

(1) J. Euvrard, Y. Yan, D.B. Mitzi, *Nat. Rev. Mater*., **2021**, *6*, 531–549.

(2) N. Xu, X. Qi, Z. Shen, et al., *Nat. Rev. Phys*., **2025**, *7*, 554–564.

[Poster 02-48]

Standardisation of Gate-Dependent Mobility Measurements in Organic Electrochemical Transistors

Youhyun Nam[a,#], Ji Hwan Kim[a,b], Tae Hoon Kim[a], Eunje Park[a], Yeonjoo Kim[a], Keehoon Kang[a,*]
[a]Department of Materials Science and Engineering, Seoul National University, Seoul, 08826, Republic of Korea
[b]Cavendish Laboratory, University of Cambridge, Cambridge, CB3 0HE, United Kingdom
Email: keehoon.kang@snu.ac.kr

Keywords: Organic Ionic-Electronic Mixed Conductors, Organic Electrochemical Transistors, Mobility, Charge Transport, Doping

Understanding the mechanisms of electronic charge transport in organic mixed ionic electronic conductors (OMIECs) is essential for the rational design of materials for organic electrochemical transistors (OECTs), which are emerging as key devices for sensing, neuromorphic computing, and bioelectronic applications.[1] A central aspect of this understanding is the dependence of electronic mobility on charge carrier density, which manifests as gate dependent mobility in OECTs. However, reliable measurement of this property remains challenging. Conventional methods based on transfer curve analysis are prone to error propagation arising from uncertainties in capacitance and film thickness, while approaches relying on charge carrier transit time can be affected by Faradaic side reactions that compromise measurement accuracy.[2]

In this study we present and validate measurement platforms for the accurate characterisation of gate dependent mobility using two complementary techniques, the gate dependent time of flight (GDToF) and gate dependent impedance matching (GDIM) methods. These approaches enable systematic extraction of the gate dependent mobility $\mu_{\mathrm{OECT}}(V_{\mathrm{G}})$ across a wide range of OMIEC materials and device geometries. By benchmarking the accuracy of $\mu_{\mathrm{OECT}}(V_{\mathrm{G}})$ measurement results, and by analysing the corresponding electrochemical response through an equivalent circuit model, we establish practical guidelines and standard conditions for reliable mobility extraction and provide a general framework for selecting appropriate measurement regimes and for interpreting mobility profiles with improved fidelity.

The combined GDToF and GDIM methodologies offer a robust and reproducible route to quantify gate dependent mobility in OECTs, enabling consistent comparison of mixed conductors with different electrochemical characteristics and geometries. This work advances the experimental foundation for charge transport analysis in OMIECs and supports the development of standardised characterisation protocols that will accelerate materials optimisation and the design of next generation bioelectronic and neuromorphic systems.

[References]

(1) B. D. Paulsen, K. Tybrandt, E. Stavrinidou, J. Rivnay, *Nat. Mater.* **2020**, *19*, 13.

(2) Y. Kim, J. Kimpel, A. Giovannitti, C. Müller, *Nat. Commun.* **2024**, *15*, 7606.

[Poster 02-49]

Enhancing Mixed Transport in Donor-Acceptor Polymers via Electrochemical Doping-tolerant Morphology Engineering

Tae Hoon Kim[a, #], Shinbee Oh[b], Ji Hwan Kim[a], Dahyun Jeong[b], Bumjoon Kim[b], Keehoon Kang[a,*]
[a]Department of Materials Science and Engineering, Seoul National University, Seoul 08826, Republic of Korea
[b]Department of Chemical and Biomolecular Engineering Korea Advanced Institute of Science and Technology (KAIST) Daejeon 34141, Republic of Korea
Email: keehoon.kang@snu.ac.kr

Keywords: Organic Electrochemical Transistors (OECT), Organic Mixed Ionic Electronic Conductors (OMIECs), D-A polymer, Electrochemical doping.

Organic electrochemical transistors (OECTs) operate through the interplay of ionic and electronic conduction within organic mixed ionic-electronic conductors (OMIECs). where molecular structure critically influences transport behavior[1]. To modulate these properties, chalcogenophene substitution offers a powerful approach for tuning intra- and intermolecular interactions in conjugated systems[2]. In this study, We report diketopyrrolopyrrole (DPP)-based polymers with aliphatic-glycol side chains (PDPP-4EG-T2 and PDPP-4EG-Se2) and reveal that chalcogen substitution enhances backbone planarity, polarizability, and quinoidal character, improving π–π stacking and charge transport. PDPP-4EG-Se2 exhibits exceptional mobility (9.8 $cm^2\ V^{-1}\ s^{-1}$) and μC* (786 $F\ cm^{-1}\ V^{-1}\ s^{-1}$) with high operational stability. Using it as both electrode and channel, unipolar inverters and ring oscillators achieve <10 nW power consumption and 40.6 V/V gain, highlighting the advantage of doping-tolerant quinoidal frameworks and ordered structures for high-performance OECTs.

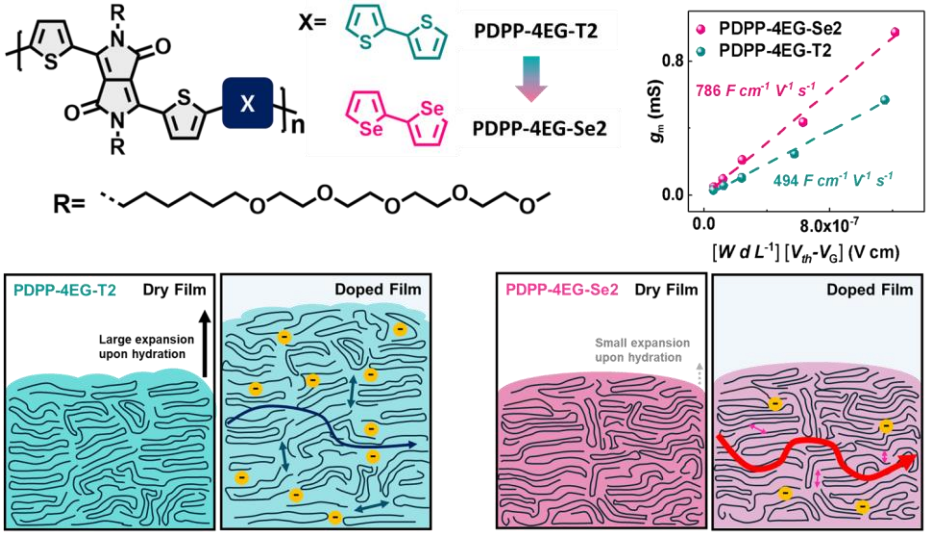


Fig. 1. Chemical structures of PDPP-4EG-T2 and PDPP-4EG-Se2, μC* of the OECTs

[References]

(1) B. D. Paulsen, K. Tybrandt, E. Stavrinidou, J. Rivnay, *Nat. Mater*. **2020**, *19*, 13.

(2) B. D. Paulsen, D. Meli, M. Moser, A. Marks, J. F. Ponder Jr, R. Wu, E. A. Schafer, J. Strzalka, Q. Zhang, I. McCulloch, *Chem. Mater*. **2024**, *36*, 1818.

[Poster 02-50]

Mechanochemical Engineering of 0D/1D Ternary Metal Halide Heterostructure for White-light Emission

Jaeyoon Cho[a,#], Yongjin Kim[a], Jae Il Kim[a], Jeongjae Lee[a], Kyeong-Yoon Baek[b], Hyeonmin Choi[a], Takhee Lee[b], and Keehoon Kang[a,*]
[a]Department of Materials Science and Engineering, Seoul National University, Seoul, Republic of Korea
[b]Department of Physics, Harvard University, Cambridge, United States of America
[c]Department of Physics and Astronomy, Seoul National University, Seoul, Republic of Korea
Email: keehoon.kang@snu.ac.kr

Keywords: Ternary metal halide, optoelectronics, heterostructure, mechanochemistry, white light emitting diode

Ternary metal halides received wide attention for optoelectronic applications due to their surpassing optoelectronic properties like superior photoluminescence quantum yield from their low dimensionality of electronic structures. Particularly, lead-free cesium copper iodide has emerged as appropriate candidates for white light emitters with broadband self-trapped exciton emission. However, the formation of low-emissive hetero-phase system during the synthesis lowers overall efficiency and therefore strategies for boosting the efficiency of overall white light emission is critical for developing lead-free ternary metal halide-based white light emitters. Herein, we designed an appropriate formation route for highly emissive white emitting heterostructure system via mechanochemical synthesis with exploring the photophysical properties in emissive heterostructure. We also demonstrated UV-converted white light emitting device with optimized heterostructure, which can further shine light on their further optoelectronic applications.

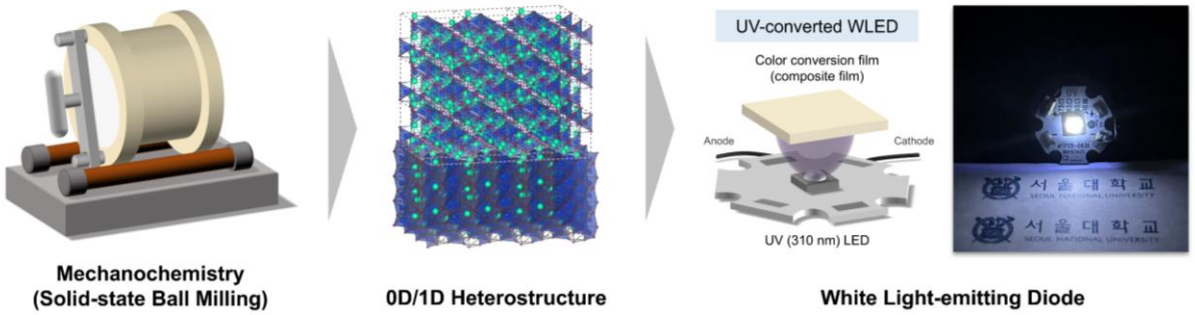


Fig. 1. Designing ternary metal halide heterostructure by mechanochemistry for white-light emitting diode.

[Poster 02-51]

Dual-functional Additive Strategy for Stable and Efficient Lead-based Halide Perovskite Electronics

Jungyoon Choi[a,#], Yongjin Kim[a], Taehyun Kong[a], Junpyo Lee[a], Hyeonmin Choi[a], Jaeyoon Cho[a], Dohyun Kim[a] and Keehoon Kang[a,*]

[a]Department of Materials Science and Engineering, Seoul National University, Seoul, Republic of Korea

Email: keehoon.kang@snu.ac.kr[*]

Keywords: metal halide perovskite, electronics, additive engineering, defect passivation

Metal halide perovskites are promising materials for next-generation optoelectronics owing to their excellent optoelectronic properties and facile solution processability. Among them, formamidinium lead iodide ($FAPbI_3$) exhibits superior thermal and electronic characteristics, yet stabilizing its photoactive α-phase remains challenging. Methylammonium chloride (MACl) has been widely used as a crystallization additive to promote α-phase formation; however, its high volatility and residual MA^+ ions lead to poor film uniformity, pinhole formation, and reduced thermal stability. In addition, Pb-based perovskites are prone to ionic migration through halide vacancies, requiring simultaneous defect passivation to ensure stable device performance.

Here, we introduce a dual-functional additive that regulates crystallization and passivates defect sites, enabling the formation of highly oriented and compact α-$FAPbI_3$ films. During nucleation and growth, the additive transiently coordinates with Pb^{2+} ions, directing uniform crystal orientation, while its residual functional groups remain at grain boundaries to suppress halide vacancy-induced ion migration. As a result, perovskite thin films fabricated with this approach exhibit improved surface coverage, reduced trap density, and a threefold enhancement in field-effect mobility compared to MACl-treated films. Furthermore, the devices demonstrate enhanced ambient stability and reduced bias-induced degradation, validating the dual functionality of the additive. This strategy provides a robust and versatile route toward stable, high-performance perovskite electronic devices by integrating crystallization control and defect passivation within a single molecular framework.

[Poster 02-52]

Solid Polymer Electrolyte Gated Tin Halide Perovskite Field-Effect Transistors

Taemin Jung[a,#], Yongjin Kim[a], Dohyun Kim[a], Jaeyoon Cho[a], and Keehoon Kang[a,*]
[a]Department of Materials Science and Engineering, Seoul National University, Seoul, Republic of Korea
Email: keehoon.kang@snu.ac.kr[*]

Keywords: Tin Halide Perovskite, Transistor, Polymer Electrolyte, Electrolyte-Gated Transistor, Compatibility

Tin halide perovskite is a promising next-generation semiconducting material for various application such as Field-Effect Transistors (FETs) and solar cells, owing to their unique properties of high carrier mobility, tunable bandgap, low toxicity, solution processability. In the case of a conventional perovskite FET using SiO_2 dielectric which has a low dielectric constant, the voltage operation window is relatively high, which leads to a high energy consumption. Here, we demonstrate an electrolyte gated perovskite FET, employing a polymer electrolyte as a gate dielectric compatible with perovskite films. The developed polymer electrolyte with a high gate capacitance and an optimal ionic conductivity enables FET device performance operating in a low-voltage range, as well as a precise conductance control. Our work highlights the demonstration of utilizing polymer-electrolyte as a gate dielectric for perovskite FETs, providing a distinctive approach to high performance perovskite electronics.

[Poster 02-53]

Volatile Pseudohalide-Assisted Crystallization of Phase-Pure Quasi-2D Tin Halide Perovskites for High-Performance Field-Effect Transistors

Hyeonmin Choi[a,#], Jaeyoon Cho[a], Junpyo Lee[a], Do-Kyoung Lee[b], Carolin M. Sutter-Fella[b], Keehoon Kang[a,*]
[a]Department of Materials Science and Engineering, Seoul National University, Seoul 08826, Republic of Korea
[b]Molecular Foundry, Lawrence Berkeley National Laboratory, Berkeley, CA, USA..
Email: keehoon.kang@snu.ac.kr

Keywords: Metal-halide perovskite, Field-effect transistor, Quasi-2D, Tin perovskite, Crystallisation

Two-dimensional tin halide perovskites have emerged as promising channel materials for field-effect transistors (FETs), offering low toxicity and high carrier mobility.[1,2] Among these, the n = 2 Ruddlesden–Popper phase represents an optimal compromise between structural robustness and efficient charge transport. In contrast, the n = 1 phase suffers from poor interlayer connectivity, while the 3D phase exhibits inferior environmental stability. However, obtaining phase-pure n = 2 films remains inherently difficult, as the crystallization process tends to favour the thermodynamically stable n = 1 and 3D phases. In this study, we introduce a volatile pseudohalide additive that selectively promotes the formation of the n = 2 phase while suppressing undesired competing phases. The resulting films exhibit a highly ordered layered structure, enabling FETs with significantly enhanced hole mobility (~5.7 $cm^2 V^{-1} s^{-1}$) and minimal hysteresis (~0.1 V). These findings demonstrate that volatile pseudohalides offer a powerful route for phase-selective crystallization, unlocking the full potential of n = 2 tin-based perovskites for high-performance electronic devices.

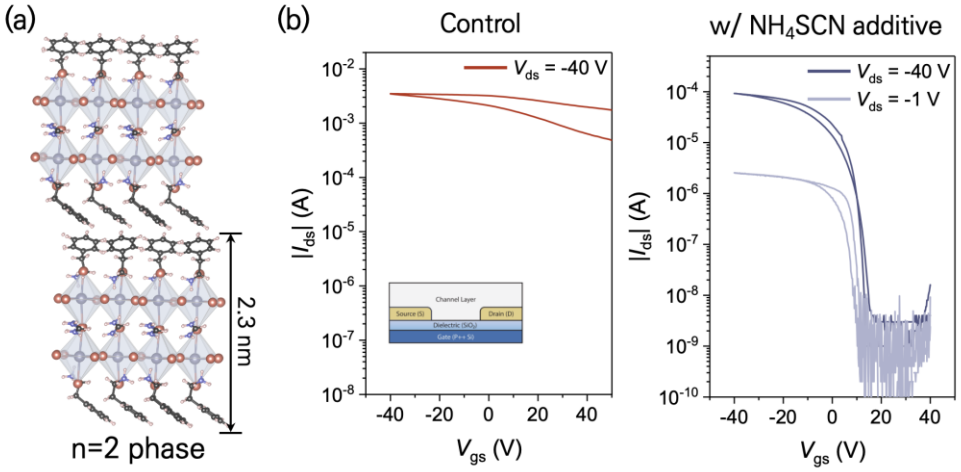


Fig 1. (a) Crytal structure and (b) FET characteristic of n=2 phase perovskite transistor

[References]

(1) Liang, Y.; Li, F.; Zheng, R. *Adv. Electron. Mater.* **2020**, *6* (9), 1– 29

(2) Kim, Y.; Choi, H.; Lee, J.; Jung, Y.; Jung, J.; Cho, J.; Lee, T.; Kang, K. *EcoMat* **2023**, *5* (11).

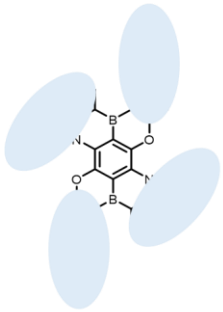
[Poster 02-54]

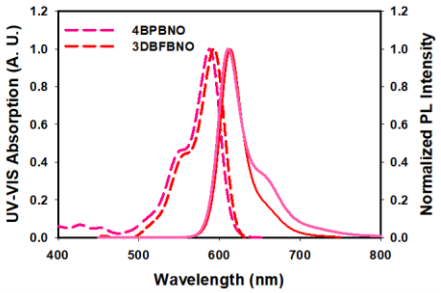
High-Efficiency Narrowband Red PSF OLEDs Achieving BT.2020 with Ultralow Roll-Off and Long Operational Lifetime

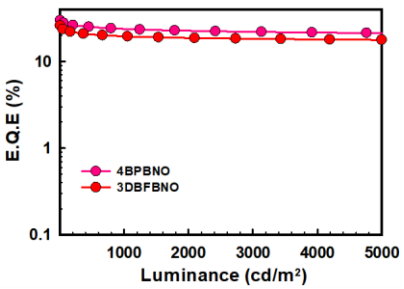
Meghana Tirupati[a,#], Nisha Vergineya S[a], Jang Hyuk Kwon[a,*]
[a]Organic Optoelectronic Device Lab. (OODL), Department of Information Display, Kyung Hee University,26, Kyungheedae-ro, Dongdaemun-gu, Seoul 02447, Republic of Korea.
Email: jhkwon@khu.ac.kr

Keywords: RED MR-TADF, OLED, B.T.2020, lifetime, efficiency

OLEDs have emerged as leading candidates for next-generation display. Next-generation displays require emitters with exceptional color purity and efficiency to meet the stringent BT.2020 standard. Multi-resonance (MR) emitters, featuring alternating electron-donating(N/O) and withdrawing units(B), suppress structural relaxation and vibronic coupling, enabling narrowband emission with high PLQYs, negligible Stokes shifts, and superior color fidelity for advanced OLED technologies. Although blue and green MR emitters have achieved narrowband emissions (FWHM < 20 nm), developing red MR emitters with FWHM < 35 nm remains challenging due to the difficulty of extending emission into the red region while maintaining spectral sharpness. Conventional strategies rely on enhancing charge-transfer (CT) character through donor–acceptor substitution or B–π–B/N–π–N frameworks, but this often causes structural relaxation and spectral broadening. To address these limitations, we propose a molecular engineering strategy that synergistically tunes π-conjugation and donor strength in a double-boron-embedded MR core, while preserving the nonbonding framework to achieve narrowband red emission with high PLQY. Herein we developed two red MR-TADF emitters based on the fusing two BNO core moieties and successfully synthesized the two red MR-TADF 4BPBNO and 3DBFBNO emitters based on the para-B-π-B, N- π -N and O- π -O pairs double boron strategy tuned the emission spectra into pure -red region, while maintaining the narrow FWHM. The Uv-visible and PL of 4BPBNO and 3DBFBNO are 587/611nm and 593/613 nm with narrow FWHM of 36 and 32 nm respectively with gradually bathochromic shift in the emission which is associated with the molecular design strategy 4BPBNO by linear conjugation, on the other hand 3DBFBNO by introduced five-membered heterocyclic analogues. The OLED fabricated with these materials shows high efficiency of 30% and 29% with corresponding CIE(x,y) (0.66,0.34) and (0.66,0.34) for 4BPBNO and 3DBFBNO respectively with ultra-low efficiency roll-off <5% until 5000 Cd/m^2.These materials also exhibited longer lifetime of 584h and 571h@5000 nits for 4BPBNO and 3DBFBNO respectively. These results highlight our molecular design strategy for red OLED to achieve ultra-high efficiency with longer operational lifetime towards achieving the B.T.2020 standards







[Poster 02-55]

Engineered Anthracene–Naphthobenzofuran Hosts for High-Performance Blue Fluorescent OLEDs

Aradhya Rajput[a,#], Meghana Tirupati[a], Jang Hyuk Kwon[a,*]
[a]Organic Optoelectronic Device Lab. (OODL), Department of Information Display, Kyung Hee University,26, Kyungheedae-ro, Dongdaemun-gu, Seoul 02447, Republic of Korea.
Email: jhkwon@khu.ac.kr

Keywords: Triplet-Triplet annihilation, anthracene, efficiency, lifetime, blue OLED.

OLEDs have rapidly advance, driving their widespread adoption in high-end display and lighting technologies. On an industrial scale, conventional fluorescence emitter-based green and red OLEDs have been superseded by phosphorescence and TADF based OLEDs due to their superior exciton utilization1. However, achieving high efficiency in blue F-OLEDs remains a challenge that continue to limit device performance. To address this issue, TTA materials have emerged as promising candidates for enhancing blue F-OLED efficiency. Non-radiative triplet excitons can be recycled by TTA-based emitters enhances device in IQE by up to 62.5% theoretically2. TTA OLEDs outperform blue phosphorescence and TADF OLEDs in terms of color purity, efficiency roll-off resistance, and operational lifetime. This performance bottleneck is primarily attributed to two fundamental factors. Firstly, the PLQY of many host materials remains suboptimal. Second, inefficient light out-coupling arising from a low proportion of horizontally aligned emissive dipoles further suppresses device efficiency and hinders the realization of theoretical EQE limits. In this context, we developed two anthracene-based host materials, NBFPAn and NBFNAn. Their planar structures effectively suppress intermolecular π–π stacking, minimizing excimer formation, and facilitating efficient singlet energy transfer to the dopant. The doped host films with MR-TADF emitter m-t-DABNA, the host films exhibit PLQYs of 84.2% (NBFPAn) and 93.9% (NBFNAn) respectively. Devices employing these hosts achieve deep blue emission of λem 463 nm, with EQEmax of 10.5% and 8.56% for NBFPAn and NBFNAn, respectively. Notably, the NBFPAn based device exhibits an extended lifetime (LT90) of 45 h at 1000 cd m^{-2}. This work underscores the critical role of molecular engineering towards enhancing device efficiency and operational lifetime for next-generation high-performance blue OLEDs.

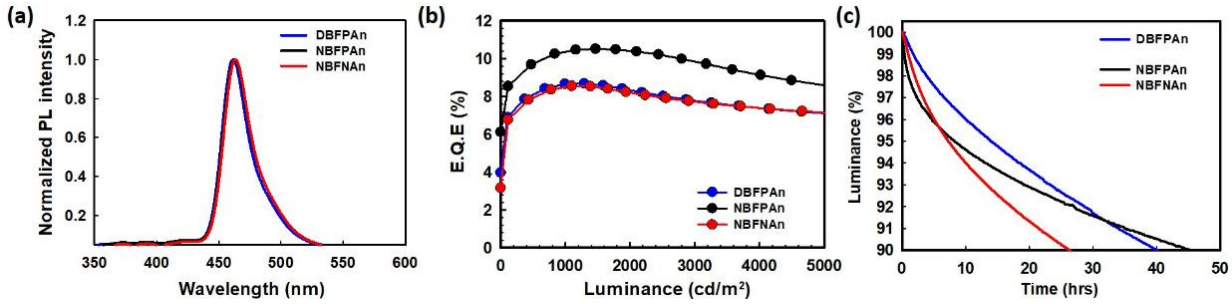


Fig 1. (a) fluorescence spectra (b) EQE luminance curve (c) Operation lifetime spectra.

[Poster 02-56]

Extending the Photodetection Limit of Organic Photodiodes Beyond 1,000 nm via an Open-Shell Terpolymer

Moon-Ki Jeong[a,#], Joon Hak Oh[a,*]
[a]Department of Chemical and Biological Engineering, Institute of Chemical Processes, Seoul National University, Seoul 08826, Republic of Korea
Email: Joonhoh@snu.ac.kr

Keywords: open-shell polymer, conjugated polymer, NIR organic photodiode, donor–acceptor material, organic semiconductor

Near-infrared (NIR) photodetectors are essential for optical communication[1], medical diagnostics[2], and autonomous sensing[3], yet conventional organic photodetectors (OPDs) rarely respond beyond 1000 nm because of their limited absorption and instability at extremely narrow band gaps. Here, we report an open-shell conjugated terpolymer, poly{2,5-bis(2-decyltetradecyl)-3,6-di(thiophen-2-yl)-2,5-dihydropyrrolo[3,4-c]pyrrole-1,4-dione-co-thiophene-co-benzo[1,2-c;4,5-c′]bis[1,2,5]thiadiazole} (PDPPTBBT), that exhibits stable diradical characteristics and extended NIR absorption surpassing 1,000 nm. The polymer was synthesized via Stille coupling of diketopyrrolopyrrole (DPP), thiophene, and benzo[1,2-c;4,5-c′]bis[1,2,5]thiadiazole (BBT) units to form a random terpolymer with strong intermolecular aggregation and a narrow optical band gap (0.75 eV). Density-functional-theory calculations revealed that the incorporation of BBT induces a diradical ground state with a small singlet–triplet gap (ΔE_{ST} ~ 14.3 × 10^{-3} kcal mol^{-1}). Electron-paramagnetic-resonance (EPR) analysis confirmed temperature-independent Pauli paramagnetism (χ_{Pauli} ~ 3.2 μemu g^{-1} Oe^{-1}), indicating delocalized unpaired spins within the π-conjugated backbone. Upon thermal annealing, enhanced π–π stacking stabilized these diradicals and strengthened the absorption shoulder near 1200 nm. Grazing-incidence wide-angle X-ray scattering (GIWAXS) demonstrated improved lamellar ordering and reduced d-spacing, consistent with intensified interchain coupling. Interestingly, PDPPTBBT functions as both electron donor and acceptor, depending on the blending component. When mixed with poly(3-hexylthiophene-2,5-diyl) (P3HT), it acts as an acceptor, whereas with Y6, it serves as a donor. Bulk-heterojunction OPDs with configurations ITO/ZnO/active/MoO_3/Au were fabricated using PDPPTBBT:P3HT and PDPPTBBT:Y6 blends. Both devices exhibited low dark currents (< 10 μA cm^{-2} at −10 V) and broad NIR sensitivity. The PDPPTBBT:Y6 device achieved a maximum external quantum efficiency (EQE) of 126% at 1050 nm and a specific detectivity (D^*) of 7.5 × 10^{11} Jones, while the PDPPTBBT:P3HT device delivered an EQE of 153% at 850 nm. The enhanced diradical stability through controlled aggregation and thermal ordering is key to balancing sensitivity, detectivity, and response speed. In summary, the open-shell terpolymer PDPPTBBT represents a new materials strategy for solution-processable, broadband NIR OPDs that operate beyond 1000 nm, combining magnetic stability, optical tunability, and dual donor–acceptor versatility. This study provides molecular design guidelines for next-generation organic photodetectors targeting long-wavelength, low-power, and flexible optoelectronic applications.

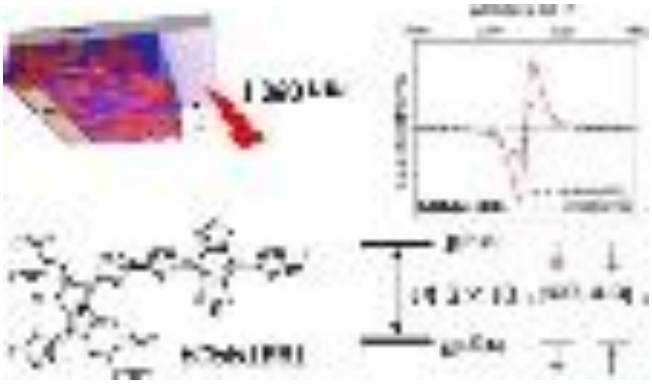


Fig. 1. Structure and diradical properties of PDPPTBBT showing a triplet ground state and NIR response up to 1050 nm.

[References]

(1) L. Li, D. Wang, D. Zhang, W. Ran, Y. Yan, Z. Li, L. Wang, G. Shen, *Adv. Funct. Mater.* **2021**, *31*, 2104782.

(2) Vitorino, R.; Barros, A. S.; Guedes, S.; Caixeta, D. C.; Sabino-Silva, R. *Photodiagnosis Photodyn. Ther.* **2023**, *42*, 103633

(3) Jeong, M.-K.; Kang, J.; Park, D.; Yim, S.; Jung, I. H. A . *J. Mater. Chem. C* **2020**, *8*, 2542– 2550

[Poster 02-57]

Suppressing Aggregation through a Rigid DOBNA-Based Host for Ultralong-Lifetime Red Solution-Processed OLEDs

Yeonjoo Lee[a,#], Thi Ma Leb [a,b], Kwang Pyo Hong [a], Soon-Ki Kwon [a], Min Chul Suh [b,*] and Yun-Hi Kim [a,*]
[a]Department of Chemistry and RIMA Gyeongsang National University Jinju 52828, Republic of Korea
[b]Department of Information Display Kyung Hee UniversitySeoul 02447, Republic of Korea
Email: ykim@gnu.ac.kr

Keywords: Solution-processed OLEDs, Host design, DOBNA structure, Charge balance, Device stability

Solution-processed OLEDs (s-OLEDs) enable low-cost, scalable fabrication but suffer from short lifetimes and exciton quenching. To overcome this, indacene-based bipolar hosts with controlled intramolecular rotation were designed: flexible DITI-QSi and rigid DITI-tDOBNA. The DOBNA framework with tert-butyl groups suppresses aggregation and enhances PLQY, while boron improves electron transport. A red phosphorescent s-OLED using DITI-tDOBNA achieved 25.1 cd/A, EQE 18.6%, and LT_{50} = 1400 h at 1000 cd/m²—among the best stabilities reported. These results highlight rigid DOBNA-based hosts as promising platforms for long-lifetime, commercialization-ready s-OLEDs.

(1) F. Samaeifar, H. Yu, T. Davidson-Hall, M. Sadeghianlemraski, D. S.Chung, H. Aziz, *J. Phys. Chem. C* **2021**, 125, 20094.

(2) D. A. Ahn, S. Lee, J. Chung, Y. Park, M. C. Suh, ACS *Appl. Mater. In-terfaces* **2017**, 9, 22748.

[Poster 02-58]

Photoelectrochemical cells with all-organic photoanodes

Jiwoo Yeop[1, 3, #], Jae Hoon Son[2], Han Young Woo[2], and Jin Young Kim[3, *]

[1] Department of Chemistry and RIMA, Gyeongsang National University, Jinju, 660-701, Republic of Korea.

[2] Department of Chemistry, Korea University, Seoul 02841, Republic of Korea.

[3] School of Energy and Chemical Engineering, Ulsan National Institute of Science and Technology (UNIST), Ulsan 44919, Republic of Korea.

Email: jykim@unist.ac.kr

Keywords: organic photoanode, n-type SAM, work function optimization, conjugated polyelectrolyte, long-term stability

Organic photoelectrochemical (OPEC) cells are efficient at generating photocurrents but face significant challenges in long-term stability due to the incompatibility of metal oxide charge transport layers with organic photoactive materials and their pH sensitivity. To overcome these issues, we developed an all-organic photoanode incorporating n-type self-assembled monolayers (SAMs) with imide core modifications, which optimize the work function of the ITO substrate, improving charge transfer and the onset potential (Vonset). The addition of a hole-transporting p-type conjugated polyelectrolyte (TPAFS-7TMA) further enhances hole transport and water wettability. This photoanode, designed for ascorbic acid oxidation, achieved a Vonset of 0.25 VRHE, a photocurrent density (Jph) of 7.92 mA cm^{-2} at oxidation potential, and retained 90% of its initial Jph over 2 hours under 1 sun irradiation. This all-organic design effectively addresses the limitations of conventional OPEC cells, providing a stable and efficient alternative for durable OPEC systems.

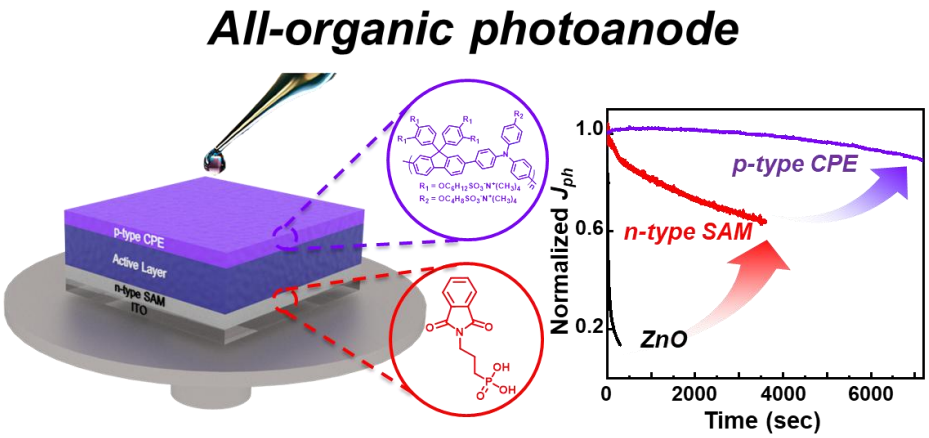


Fig 1. Schematic image of all-organic photoanode