In this work, we demonstrated that the spatial distribution of molecular dopants within highly-doped conducting polymer films affects thermoelectric (TE) properties of the films. Poly(2,5-bis(3-hexadecylthiophen-2-yl) thieno [3,2-b] thiophene) (PBTTT-C14) films were p-doped by 2,3,5,6-tetrafluoro-7,7,8,8-tetracyanoquinodimethane (F4TCNQ). Different doping methods distributed dopants in amorphous or crystalline domains, or both, of the PBTTT-C14 film. F4TCNQ molecules in the crystalline domain induced a rapid increase in the thermoelectric power factor of $\sigma S^2 \propto \sigma^{0.76}$ where σ is the electrical conductivity and S is the Seebeck coefficient. We believe that such systematic studies on the structural relation between dopants and conducting polymer chains in highly doped conducting polymers will provide guidelines for designing high-performance organic TE materials.

4PS-69 민지현
Novel IDTT-Based Additive Engineering for Surface Passivation to Boost Efficiency and Thermal Stability of Perovskite Solar Cells
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Perovskite is expected as a next-generation optoelectronic material because of its optical properties and solution processability. A novel indacenodithieno[3,2-b] thiophene-based small molecule (IDTT-ThCz) is proposed as a new additive capable of interacting with perovskite layer. The IDTT-ThCz is introduced into the perovskite layer through anti-solvent treatment to effectively passivate the defects on the surface. In addition, this passivation method effectively suppresses degradation and improves charge extraction capability. As a result, the IDTT-ThCz-based solar cell recorded a high power conversion efficiency of 22.5% and maintained 95% compared to the initial PCE after 500 hours at 85°C thermal condition. These results showed noticeable PCE and stability compared to the perovskite solar cells using small additive reported so far.

4PS-70 박상식
A Combined Spectroscopic Investigation of Charge Trapping Mechanism In Polymer Semiconducotrs for High Operational Stablity of Polymer Field-Effect Transistors
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Overcoming the low operational stability in conjugated polymer semiconductors is imperative to approach the realization of their deployment in technologically relevant applications. Although an in-depth understanding of the trapping mechanism is essential to solving such a problem, the complex nature of trapping phenomena involving multiple origins has proven to be a more difficult task. In this poster, combinatorial understanding on charge trapping mechanism for operational instability was revealed by monitoring the device properties and density of state spectrum under bias stress in cooperation with photo-excited charge de-trapping upon incident photons; the electrochemical reaction within the void of polymer semiconductors produce the trapping states and such reaction is independent to the reaction on an insulator surface. We also show that molecular design guide to suppress operational instability in polymer semiconductors.

4PS-71 박성민
Engineering Aggregation-Resistant MXene Nanosheets as Highly Conductive and Stable Inks for All-Printed Electronics
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Here, a promising trifluoroacetic acid treatment strategy is utilized for obtaining alcohol-dispersible MXene nanosheets suitable for electrohydrodynamic printing process alongside increasing their electrical conductivity. The high conductivity levels of the treated MXenes facilitated their printed patterns to be applied as gate and source/drain electrodes in all-printed logic circuits, displaying excellent and robust operation in transistors, inverters, and NAND, and NOR logic gates. in this study, a promising approach for modifying MXene nanosheets with the aim of achieving desirable properties appropriate for large-area printing processes, indicating the viability of using MXene in practical applications including all-printed electronics. * This work was supported by Korea Institute for Advancement of Technology (KIAT) grant funded by the Korea Govermment (MOTIE) (P00008500, The Competency Development Program for Inudstry Specialist). * 2021 년 한국교통대학교 지원을 받아 수행하였음.

4PS-72 박수홍
Effect of Fused Thiophene Bridges on the Efficiency of Non-Fullerene Polymer Solar Cells made with Conjugated Donor Copolymers
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New wide-bandgap donor-acceptor-π type conjugated polymers, PBTTT and PBTDTT, containing different π-extended conjugated bridges between BDT as a donating unit and 3-carboxylthiophene (3CT) as a weak electron-withdrawing group, were successfully synthesized. Thienothiophene (TT) and dithienothiophene (DTT) were selected as fused thiophene bridges for inclusion in the polymer backbone. As the conjugation length of the π-extended bridge (*i.e.*, from thiophene to DTT) increased, the bandgap of the polymer slightly decreased, and the highest occupied molecular orbital level shifted to a higher-lying level. Among the three copolymers, PBTTT-based non-fullerene polymer solar cells (NF-PSCs) with ITIC-Me showed a high power conversion efficiency of 7.30% with a high short circuit current density of 14.05 mA/cm2. The superior performance of the NF-PSCs based on PBTTT may be attributed to their predominant face-on orientation of polymer chains and relatively more favorable surface morphology.

4PS-73 박종진
Polymer-Metal-Composite-Type Electrodes for Flexible Solar Cell Applications
박종진, 최강서, 신소정, 윤상은, 서보은, 김종현† 아주대학교
In order to manufacture next-generation flexible solar cells, it is essential to develop flexible electrodes that have excellent surface resistance and excellent durability. Silver has been spotlighted as a major electrode material in the form of paste developed for this purpose because it has excellent electrical conductivity, and oxidative resistance. However, due to the high-cost of silver paste, application of mass-production industry is limited. To solve the problem of these silver paste electrodes, this study successfully developed low-cost electrode composite with low sheet resistance and excellent oxidation resistance by fabricating copper-coated core/shell structured composites on conducting polymer nanostructure. The sheet resistance range of the developed core/shell nanocomposite is from 10^{-3} ohm/square to 10^{-2} ohm/square making it appropriate as an electrode paste material. Air stability was also confirmed for application as a next-generation flexible solar cell electrode.

4PS-74 박진수
Optimizing Crystallinity and Hole Mobility of Benzodithiophene-Based Polymer Donor for Highly Efficient Nonfullerene Organic Solar Cells
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In this work, we develop a series of BDT-8ttTPD-based polymer donors to produce optimal crystallinity and hole mobility in nonfullerene organic solar cells. To overcome the amorphous characteristics of BDT unit, we employ planar 8ttTPD unit as a counterpart and moreover replace the hydrogen atoms attached to the third positions of side thienyl groups with halogen atoms to yield PBDT-X (X= H, F, and Cl). Synergistic effects of incorporated 8ttTPD unit and the halogenated 2D side chain generate significantly enhanced charge transport and recombination properties of the OSCs, which is mainly attributed to optimized crystallinity and hole mobility of the polymer donors. As a result, the PBDT-Cl:Y6 OSCs achieve the highest power conversion efficiency (PCE) of 15.63% with simultaneous improvements of open-circuit voltage, short-circuit current density, and fill factor, outperforming the PCEs of PBDT-H:Y6 (11.84%) and PBDT-F:Y6 (14.86%).

4PS-75 박태욱
Nanowire-Embedded Polymer Photomultiplication Type Photodiode Achieving EQE over 250,000%
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In this work, a photomultiplication-type organic photodiode (PM-OPD) with a nanowire (NW)-embedded polymer morphology is introduced aiming prolonged carrier lifetime and enhanced carrier mobility, which contribute to more efficient gain generation. Well-defined NWs with low structural defects within P3HT:PC71BM (100:1 w/w) bulk-heterojunction (BHJ) active layer is achieved using a typical aging method. Transient photocurrent analyses show that the NW-embedded P3HT morphology suppresses electron detrapping from localized PC71BM, leading to prolonged minority carrier recombination time. Space charge limited current study shows that gradual increase in NW density in BHJ film can lead to increase of hole mobility along the vertical direction, due to increasing of efficient percolation pathways. Remarkable increase of EQE up to 250,000%, responsivity up to 1300 A W^{-1} and high specific detectivity up to 6.3×10^{13} Jones can be realized by embedding NW into conventional PM-OPD structure.

4PS-76 박형진
Siloxane-Functionalized Side Chains Conjugated Polymer with Thieno[3,2-b]thiophene for Non-fullerene Organic Solar Cells
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The new polymer Nap-SiBTA is designed and synthesized for fabrication of non-fullerene organic solar cells (NFOSCs) application. Nap-SiBTA comprised of 4,8-bis(5-(6-((2-hexyldecyl)oxy)naphthalen-2-yl)thiophen-2-yl)benzo[1,2-b:4,5-b']dithiophene as donor and 4,7-bis(5-bromothieno[3,2-b]thiophen-2-yl)-5,6-difluoro-2-(6-(1,1,1,3,5,5,5-heptamethyltrisiloxan-3-yl)hexyl)-2H-benzo[d][1,2,3]triazole (SiBTA) as acceptor. The thermal, photophysical and electrochemical properties of Nap-SiBTA were systematically investigated. Interestingly, Nap-SiBTA exhibited wide band gap of 1.90 eV with highest occupied molecular orbital (HOMO) = -5.30 eV and lowest unoccupied molecular orbital (LUMO) = -3.40 eV, and showed better compatibility with IT-4F as non-fullerene acceptor. Therefore, Nap-SiBTA blended with IT-4F exhibited a efficiency of 7.30 %, open-circuit voltage of 0.80 V, a short-circuit current density of 17.80 mA/cm^2, and fill factor of 50.61%, respectively.

4PS-77 배수종
Evaluation of the Electrochemical Performance of Polymeric Binders for High Perofrmance Silicon Anode in Lithium-Ion Batteries
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Developing high-energy-density and good cycling stability of lithium ion batteries is regarded as the core of next-generation rechargeable batteries. However, the considerable volume variation during the lithiation and delithiation process drives big challenges to its commercialization in lithium-ion batteries. In this study, silicon composite anodes with the three-dimensionally cross-linked binder (c-PAA-CMC) ; poly(acrylic acid) and sodium carboxymethyl cellulose, which possess mechanical resistance to strain, are fabricated and evaluated. Compared with the Silicon composite anodes with the polyvinylidene fluoride binder, three-dimensionally interconnected binder indicates a significantly enhanced reversible capacity and a high initial coulombic efficiency of 88.2%. The three-dimensionally cross-linked binders provide promising way to develop next generation Lithium ion battery with high-energy-density and good cycle performance.

4PS-78 서경욱
The Improvement of the Dark Current on Organic Photodetectors with Modified PEDOT:PSS to Change Contact Angle
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Organic photodetectors (OPDs) overcome the disadvantages of the traditional inorganic photodetectors in terms of their unique features, such as rich in varieties, light weight, ease of processing, large-area scalability, and high flexibility. Among them, photo-responsive materials used in OPDs have low band gap energy, and dark current is likely to occur by other factors except light. Poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) was used as typical hole transport layer. The contact angle between a liquid film and a solid substrate is treated in the van der Waals Model, and it has an important role in defects and dark current between the interfaces. We mainly improved the dark current, using the Hydrophobic modified PEDOT:PSS-co-TF