

조미영, 하예은, 원용선, 김주현[†] 부경대학교

π -conjugated polyelectrolytes (CPEs) have been commonly used as an interfacial layer for polymer solar cells (PSCs) over the past decade. In the CPEs, polymers which consist of fluorene derivatives as the backbone are usually applied to PSCs. To improve the photovoltaic properties, we synthesized CPEs having electron rich moiety, phenothiazine, and compared to those of the fluorene homopolymer. From the density functional theory (DFT) and ultraviolet photoelectron spectroscopy (UPS) data, we also confirmed that conformations of synthesized CPEs have influence on the work function of metal and morphology of film. In this presentation, we will report the synthesis, conformations of CPEs, and photovoltaic properties.

3PS-277 조민주

Control of Molecular Structure for Improving the Charge Transport Property in π -Extended Diketopyrrolopyrrole-containing Polymers

조민주, 신지철, 이태완, Matinder Kaur, 최동훈[†] 고려대학교

Recently, diketopyrrolopyrrole (DPP)-based copolymers have attracted much attention due to the high hole mobility in thin film transistor (TFT) made of solution processing technology. These copolymers containing the strong symmetric DPP acceptor and π -extended donor endow the high crystallinity, planarity, and intermolecular interaction. When developing high performance DPP-based polymers, two important issues were addressed to enhance the charge carrier transport in OTFTs: effect of alkyl side-chain and kind of donor moiety with the π -conjugation length. In this study, we have synthesized a series of DPP-based copolymers bearing more π -extended donating units. Also, we systematically studied the effect of various donor units and donor length in these copolymers on the optical properties, film morphology, and carrier mobility in OTFT.

3PS-278 조선영

A Simple and Facile Method for Fabrication of Insoluble Electro-Spun Sheets : Chemically Cross-Linked PEO using Post-Treatment with Acid Vapor

조선영, 김중호, 김대근, 이택승[†] 충남대학교 유기소재·섬유시스템공학과

Electrospun nanocomposite is considered as one of the most highly researched areas in nanomaterials by the virtue of their improved mechanical properties, dimensional stability, thermal/chemical stability. Poly(ethylene oxide) (PEO) is a polyether compound with many applications from industrial manufacturing to medicine or functional materials. PEO can be crosslinked by γ and UV irradiation, but few reports have been made concerning the chemical crosslinking of this important and versatile polymer. In this study, we demonstrated electrospun sheets composed of PEO crosslinked with TEOS (tetraethoxy orthosilicate) by post-exposure to acid vapor. The high stability of the TEOS-reinforced fiber matrix resulted from the chemical crosslinking between hydrolyzed TEOS and PEO. Finally, we prepared "turn-off" system based on silica-reinforced electrospun PEO sheets embedded with conjugated polymer owing to fluorescence quenching by acid.

3PS-279 조세빈

Brush painted MoO₃ hole transport layer for Efficient Polymer solar cells

조세빈, 전예진, 김석순^{1,†} 전북대학교; ¹군산대학교

As an alternative to poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) hole transporting layer (HTL) in low cost solution-processable polymer solar cells (PSCs), interests in p-type like metal oxides such as molybdenum oxide (MoO₃), vanadium oxide (V₂O₅) and nickel oxide (NiO) has been increased. In particular, MoO₃ is one of the promising materials since it is known as a non-toxic material and has a well-matched energy level with P3HT to induce efficient hole transport to transparent electrode. In this study, we demonstrate bulk-heterojunction PSCs with MoO₃ produced by brush painting, which is compatible with roll-to-roll based manufacturing system. We will discuss structural, electrical, and optical characteristics of brush painted MoO₃ and their effect on performance of PSCs will be discussed.

3PS-280 조우섭

Solution processed green phosphorescent organic light emitting diodes with 4,4',4''-tris(N-carbazolyl)-triphenylamine (TCTA) as interlayer

조우섭, 진성호[†], 재갈영순[†] 부산대학교; ¹경일대학교

The extensively used hole-transporting host 4,4',4''-tris(N-carbazolyl)-triphenylamine (TCTA) as small molecule interlayer for green phosphorescent organic light emitting diodes (OLEDs) were fabricated by solution process. The OLEDs that we prepared utilizes phosphorescent dopant materials, tris(2-(4-tolyl)phenylpyridine) iridium (Ir(mppy)₃), exhibit a Commission International de l'Eclairage (CIE) coordinates of (0.300, 0.620). We have fabricated solution processed green OLEDs with a configuration of ITO/PEDOT:PSS/TCTA/PVK:mCP:Ir(mppy)₃/OXD-7/LiF/Al. The optimized interlayer OLEDs showed excellent performance such as maximum luminance efficiency of 40.8 cd/A, a maximum power efficiency of 21.4 lm/W and a maximum external quantum efficiency of 11.9% and the driving voltage of 4.3 V.

3PS-281 조한희

Effect of the Planarity on Photovoltaic Performance of Low Bandgap Polymer

조한희, 김범준[†], 강태의 KAIST 생명화학공학과

Systematic control of the chemical structure of conjugated polymers is critically important to elucidate the relationships between the conjugated polymer structures and properties and to optimize their performance in bulk heterojunction (BHJ) polymer solar cell (PSC) devices. In specific, the introduction of nitrogen atoms into the polymer backbone caused the increase in planarity of the main chain conformation and thus, optical, electrical,

and photovoltaic properties of the conjugated polymers were enhanced. To apply this concept to low bandgap polymers for further enhancement of photovoltaic performance, three different diketopyrrolopyrrole-based polymers were set as target materials. At first, a reference polymer, PDPPTT, was successfully synthesized and showed the power conversion efficiency of 4.81% when the PSC devices consisting of PDPPTT:PC₆₁BM were fabricated. The further research about the planarity-controlled low bandgap polymers will be addressed.

3PS-282 조현수

유기태양전지용 실버 나노와이어 투명전극의 적용

조현수, 박상혁[†] 공주대학교 화학과

저비용, 유연성 등의 장점을 가진 유기태양전지용 실버 나노와이어 투명전극의 적용을 위해 연구가 진행되고 있다. 현재 활용하고 있는 ITO 전극은 빛의 투과율과 저항 등의 많은 부분에서 우수한 특성을 가지고 있으나 공정 및 원료비가 비싸고 유연성을 저해하고 있다. 이 때문에 ITO 전극을 대체할 수 있는 물질의 연구 및 개발이 활발히 이루어지고 있다. 우리는 새로운 유기태양전지용 산화 전극으로 실버 나노와이어를 연구하고 있다. 실버 나노와이어는 근래에 개발된 많은 산화전극 중 ITO에 근접한 투과율과 전기적 특성을 가지고 있기 때문에 유연한 투명전극의 특징을 가지고 있다. 우리는 실버 나노와이어 전극을 유기태양전지에 적용하여 기존에 사용 하고 있는 ITO 전극을 대체할 수 있는 가능성을 확인하였다.

3PS-283 차효정

The Effect of Cyano Substituent on Nano-Scale Morphology of Bulk Heterojunction Solar Cells

차효정, 김승용, 안태규, 김유진, 권순기, 김윤희, 박찬연[†] 포항공과대학교; ¹경상대학교

The morphological and photovoltaic characteristics of naphthalene-based conjugated polymers:PC₇₁BM blends are studied with and without cyano substituted group as an electron deficient group on a conjugated polymer. PBTADN:PC₇₁BM blend solar cells exhibited an extended optical absorption over the solar spectrum and homogeneous nano-scale morphology that enhanced charge carrier transport compared to PBDTN:PC₇₁BM which does not possess cyano substituent. Without annealing processing, the bulk-heterojunction devices of PBTADN:PC₇₁BM blend yielded an open circuit voltage (V_{oc}) of 0.89 V, a current density (J_{sc}) values of 7.4 mA/cm², a fill factor (FF) of 0.51, and power conversion efficiency (PCE) values of 3.4%, showing highly increased V_{oc} and FF with respect to PBDTN:PC₇₁BM blend solar cells. This study suggests that the conjugated polymer including cyano substituted group has distinct advantages for the development of highly efficient polymer solar cells.

3PS-284 최민수

The Comparison of C₆₀ and C₇₀ in Bulk Heterojunctions Formed by Alternation Thermal Deposition

최민수, 김지환, 김효정, 김장주[†] 서울대학교

The difference between C₆₀ and C₇₀ in forming bulk heterojunctions is analyzed with synchrotron x-rays and its relationship with solar cell performance is discussed. ZnPc is used for donor and bulk heterojunctions are formed by commercial co-deposition and by alternating thermal deposition (ATD). In small angle x-ray scattering (SAXS) image, there are difference in nanostructures; ZnPc:C₆₀ system made by ATD has no columnar structure, while ZnPc:C₇₀ system made by ATD has columnar structure.

3PS-285 최윤석

Fluorine Substitution on Donor Unit in A-D-A Type Small Molecule for High V_{oc} Organic Solar Cells

최윤석, 조원호[†] 서울대학교

Since it has generally been accepted that the V_{oc} in organic photovoltaics (OPVs) is proportional to the energy difference between the HOMO of donor and the LUMO of acceptor, it is indispensable for achieving high V_{oc} to lower the HOMO energy level of donor material. For the purpose, we synthesized two different A-D-A type small molecules (SMs), where A is thiophene-capped DPP (TDPP) and D is fluorinated bithiophene (FT2) or fluorinated biphenylene (FPh2), and thus the two fluorinated SMs are denoted by FT2(TDPP)₂ and FPh2(TDPP)₂, respectively. Since fluorine has strong electron-withdrawing property, it is expected that the introduction of fluorine atom onto the D unit in A-D-A type SMs lowers its HOMO energy level, resulting in enhancement of V_{oc} of OPV cell. The HOMO energy levels of fluorinated SMs were deeper than those of non-substituted ones by 0.07 eV. FT2(TDPP)₂ and FPh2(TDPP)₂ exhibit high V_{oc} of 0.87 and 0.95 V, respectively.

3PS-286 최하림

Surface-induced Crystal Structures of Organic Semiconductors on High- κ Polymer Dielectrics

최하림, 장 미, 양희창[†] 인하대학교

Organic field-effect transistors (OFETs) need to be reliably operable at low voltages for prolonged periods of time. In order to achieve low operating voltages, many research groups have focused on high gate-capacitance structures, which can be produced by increasing the dielectric constant and/or decreasing the film thickness. The high- κ materials that usually include ionic impurities or polar functionalities can cause irreversible hysteresis and bias stress behavior. In contrast, ferroelectric poly(vinylidene fluoride-trifluoroethylene) (PVDF-TrFE) has tunable crystal structures and high dielectric constant. Here, PVDF-TrFE blend films were used as gate dielectrics to vacuum-processed OFETs. Surface properties of the PVDF-TrFE blend films could be optimized via controlling the crystalline behavior, without any drastic drop in the overall dielectric constant. Then, pentacene OFETs were fabricated and characterized.

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Fluorine Substitution on Donor Unit in A-D-A Type Small Molecule for High V_{oc} Organic Solar Cells



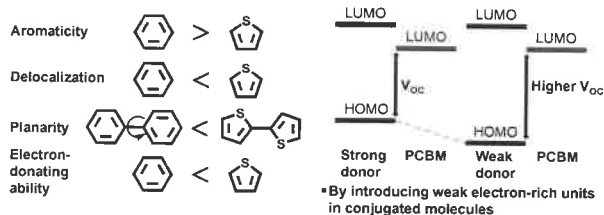
최윤석, 조원호*

서울대학교 재료공학부

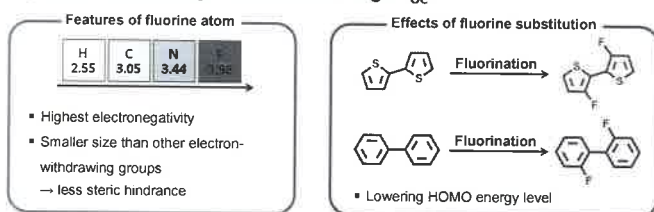
Introduction

❖ Energy level tuning of D-A type materials

✓ Weak electron-rich units for high V_{oc}



✓ Electron-withdrawing substituents for high V_{oc}



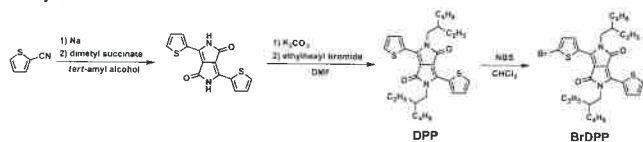
Objectives

- To synthesize DPP-based small molecules composed of highly electron-deficient diketopyrrolopyrrole (DPP) and fluorinated electron-rich units.
- To compare the photophysical and photovoltaic properties of fluorinated small molecules with those of non-fluorinated ones.

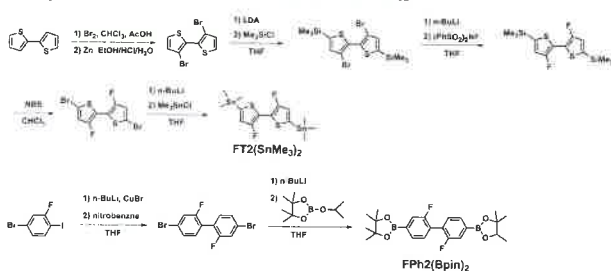
Results

❖ Synthetic scheme of small molecules

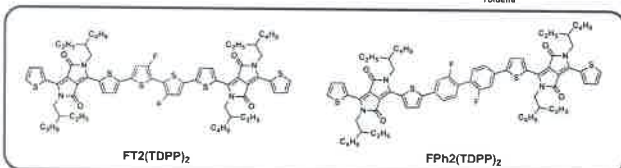
✓ Synthesis of DPP



✓ Synthesis of fluorinated electron-rich units

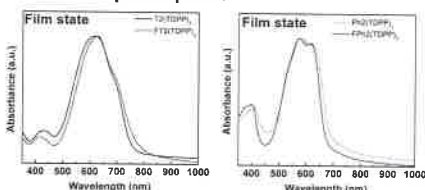


✓ Cross coupling reactions

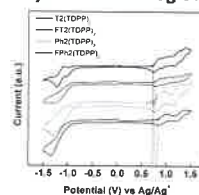


❖ Physical properties of small molecules

✓ UV absorption spectra



✓ Cyclic voltammograms



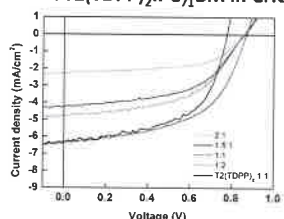
	E_g^{opt} (eV)	HOMO (eV)	LUMO (eV)	E_g^{cal} (eV)
T2(TDPP) ₂ ^{a)}	1.65	-5.14	-3.55	1.59
FT2(TDPP) ₂	1.60	-5.21	-3.54	1.67
Ph2(TDPP) ₂ ^{a)}	1.80	-5.21	-3.57	1.64
FPh2(TDPP) ₂	1.84	-5.28	-3.54	1.74

^{a)} This is performed in previous works

- Weak electron-donating power of phenylene leads to deep HOMO energy level.
- Fluorine substitution to electron-rich units exhibits deeper HOMO energy level than that of non-substituted one.

❖ Photovoltaic properties

✓ FT2(TDPP)₂:PC₇₁BM in CHCl₃, DIO 0.5 vol%

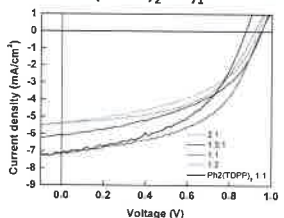


SMs ^{a)}	Blend ratio	V_{oc} (V)	J_{sc} (mA/cm ²)	FF	PCE (%)
FT2(TDPP) ₂	2:1	0.85	2.3	0.58	1.1
	1.5:1	0.86	4.3	0.51	1.9
	1:1	0.87	6.4	0.54	3.0
	1:2	0.86	4.8	0.52	2.1
T2(TDPP) ₂	1:1 ^{b)}	0.78	6.3	0.56	2.8

^{a)} Device configuration: ITO/PEDOT:PSS/SMs:PC₇₁BM/Ca/Al

^{b)} 0.5 vol% DIO is added to the solution.

✓ FPh2(TDPP)₂:PC₇₁BM in CHCl₃, DIO 0.5 vol%



SMs ^{a)}	Blend ratio	V_{oc} (V)	J_{sc} (mA/cm ²)	FF	PCE (%)
FPh2(TDPP) ₂	2:1	0.94	5.3	0.47	2.4
	1.5:1	0.95	6.1	0.47	2.7
	1:1	0.95	7.1	0.52	3.5
	1:2	0.92	5.4	0.53	2.6
Ph2(TDPP) ₂	1:1 ^{b)}	0.87	7.1	0.48	3.0

^{a)} Device configuration: ITO/PEDOT:PSS/SMs:PC₇₁BM/Ca/Al

^{b)} 0.5 vol% DIO added to the solution.

- Fluorine substituted small molecules with deeper HOMO energy level show enhanced V_{oc} and PCE.

❖ TEM images of blend film



a) FT2(TDPP)₂:PC₇₁BM 1:1
Macro-phase separated morphology

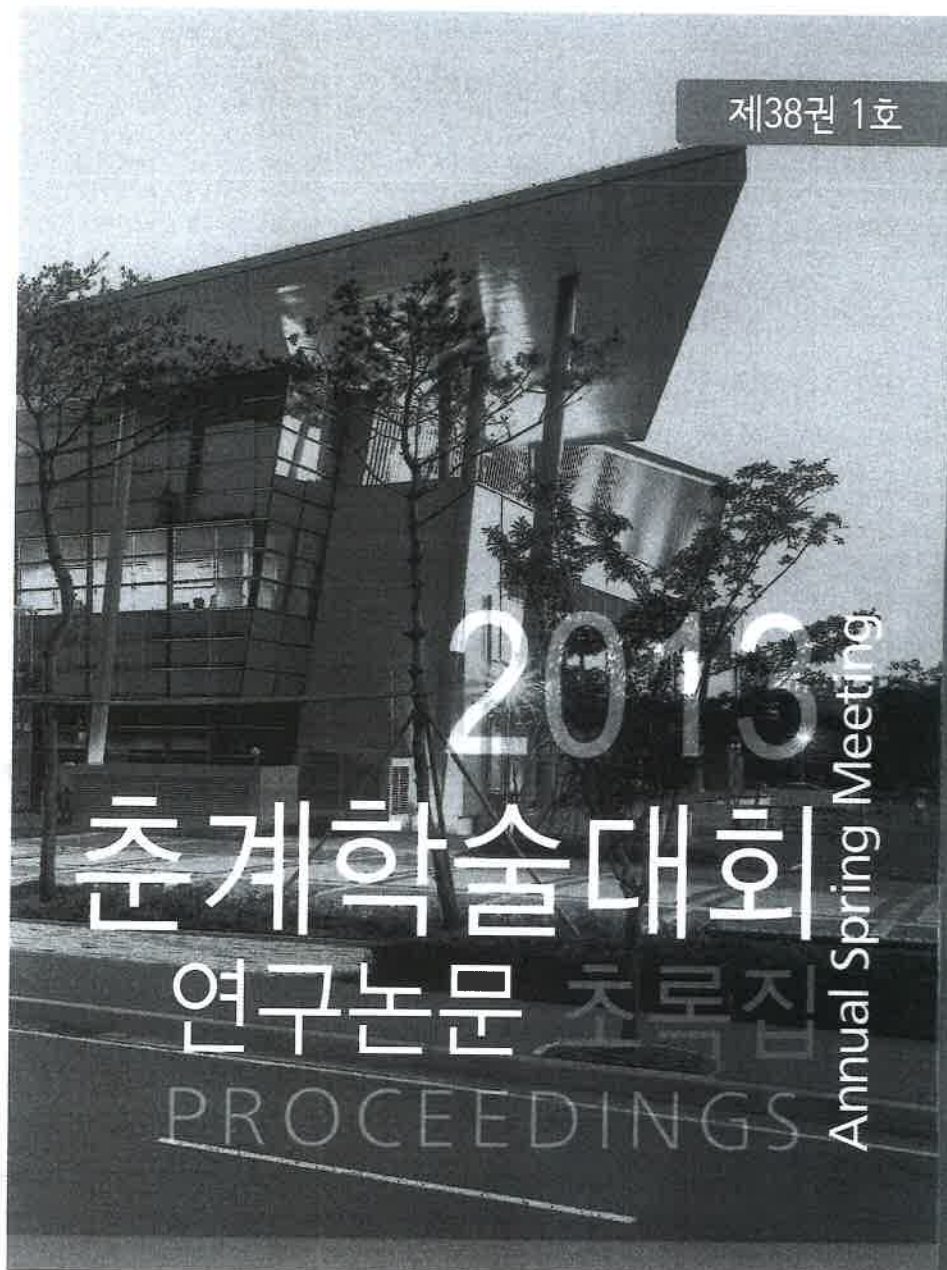
b) FPh2(TDPP)₂:PC₇₁BM 1:1
Nanostructured phase separation

→ Preferable morphology are realized in terms of charge carrier transport

Scale bar: 500 nm

Conclusions

- Fluorinated small molecules, FT2(TDPP)₂ and FPh2(TDPP)₂, are successfully synthesized and show higher V_{oc} s of 0.87 V and 0.95 V, respectively, than those of non-fluorinated ones.
- FPh2(TDPP)₂ shows the highest PCE of 3.5% at the 1:1 weight ratio of small molecules to PC₇₁BM.



2013
Annual Spring Meeting

춘계학술대회

연구논문 초록집

PROCEEDINGS

2013. 4. 11(Thu) - 12(Fri)

 한국고분자학회
The Polymer Society of Korea

 대전광역시
DAEJEON METROPOLITAN CITY

 DIME 대전마케팅공사

일 정 표

4월 11일(목)

시간	행사	장소	비고
08:00-17:30	등록	1층 로비	
09:00-10:30	포스터 발표(I) (좌장: 박재형, 김범준) (1PS-1~1PS-337)	1층 다목적홀	포스터(I) 게시
10:30-11:10	[기조강연] PL-1 고분자 산업의 새로운 르네상스 윤진녕, LG화학 (좌장: 장태현)	총회장	
11:10-11:50	[도레이고분자상 수상기념강연] PL-2 High Performance Polyimide Dielectrics and Semiconductors: Low-k dielectrics, LC-alignments and Electrical Memories 이문호, 포항공과대학교 (좌장: 장지영)		
11:50-12:50	[제 74회 정기총회(준계)] 1.개회 2. 2013년도 학회상 시상 3. 회무보고 4. 2012년도 결산승인 5. 기타토의 6. 폐회		
12:50-14:00	점 심		
14:00-18:00	초청강연 및 연구논문 발표(I) (초청강연 55편, 구두발표 45편)	각 발표회장	
18:30	간담회 및 우수논문발표상 시상	간담회장	

4월 12일(금)

시간	행사	장소	비고
8:00-16:00	등록	1층 로비	
9:00-10:30	포스터 발표(II) (좌장: 양성윤, 강영종) (2PS-1~2PS-337)	1층 다목적홀	포스터(II) 게시
10:30-12:30	초청강연 및 연구논문 발표(II) (초청강연 28편, 구두발표 12편)	각 발표회장	
12:30-14:00	점 심		
14:00-16:00	초청강연 및 연구논문 발표(III) (초청강연 28편, 구두발표 12편)	각 발표회장	포스터(III) 게시
16:00-17:30	포스터 발표(III) (좌장: 김영진, 가재원) (3PS-1~3PS-337)	1층 다목적홀	