제 39권 1호

2014 춘계학술대회 연구논문 초록집

PROCEEDINGS

The Polymer Society of Korea

2014. 4. 9 [Wed] - 11 [Fri] 대전컨벤션센터

Annual Spring Meeting

한국고분자학회
The Polymer Society of Korea

대전광역시
DAEJEON METROPOLITAN CITY

DIME 대전마케팅공사

cross-linked to achieve solvent-resistant thin films by portable UV ramp (1.9 mW/cm^2) for 5 min. After photo-crosslinking, solution processed multilayer OLEDs were prepared that showed excellent device performance.

2PS-245 박지영

Cobalt electrolytes of Quasi-solid State polymer Containing Organic Dye for Dye-sensitized Solar Cells

박지영, 정주희, 이도경, 안광순, 김재홍† 영남대학교

It is well known that the presence of traditional liquid electrolytes in dye-sensitized solar cells is related to problems such as precipitation of salts in the electrolyte at low temperature, evaporation of liquids of the electrolyte at high temperature, corrosion and lack of long-term stability of the cells. In order to overcome various problems associated with liquid electrolytes, quasi-solid-state polymer electrolytes which is well known PVDF-HFP can be used in dye-sensitized solar cells. In a DSSCs, this implies a reduction in the driving force for sensitizer regeneration and a possible increase in photovoltage and power conversion efficiency, provided that the rate of charge recombination of the cobalt bipyridyl redox couple is comparable to or slower than that for iodide mediators.

2PS-246 박지영

Organic Photo-Sensitizers of synthesized base on Multi-acceptor in a chromophore for Dye-Sensitized Solar Cells

박지영, 이치환, 안희진, 한윤수[1], 김재홍† 영남대학교: [1]대구가톨릭대학교

Since Grätzel et al. reported the first efficient dye-sensitized solar cells (DSSCs) in 1991, which have attracted much attention due to their relatively high power conversion efficiency and potentially low cost production. Organic photo-sensitizers containing multi-acceptors in a chromophore have been synthesized and characterized for the application of dye-sensitized solar cell (DSSC). In this study, we have used the intramolecular push-pull system containing phenothiazine as the electron donor with different number of cyanoacetic acid moieties as electron acceptor/anchoring groups in a chromophore. The experimental results have revealed that when the induced electron acceptor increases, the larger amounts of dyes are adsorbed on the TiO2 surface in DSSC, resulting in the increase of short circuit photocurrent density.

2PS-247 박지은

Synthesis and Structure-charge Transport properties of Donor-Acceptor Alternating Conjugated Copolymer containing Fused Thiophene and Diketopyrrolopyrrole

박지은, 신지철, 조민주, 최동훈† 고려대학교

The main chain conjugated polymers containing electron donor (D) and acceptor (A) in an alternative manner have been proposed in many literatures, which showed highly effective electron delocalization along the polymer chains owing to push-pull structures. Among many kinds of D-A copolymers, some representative fused-thiophene containing polymer systems showed much higher charge carrier mobility due to strong stacking interaction in the solid state. In this study, we synthesized new low bandgap alternating conjugated copolymer containing tetrathienoacene (TTA) and dithienothiophene (DTT) which are fused heteroaromatic ring monomers and characterized their physical properties. Thermal analysis, cyclic voltammetry and absorption spectroscopy were also employed to investigate their unique properties. Finally, we fabricated thin film transistor devices to study their charge carrier transport properties.

2PS-248 박한옥

A surface modification of metal oxide in inverted organic solar cells

박한옥, 엄승훈, 백명진, 이수형† 전북대학교

The interfacial modifier (IM) has been used to change surface properties of ZnO as a cathode buffer in inverted organic solar cells. Applied IM changed the surface property of metal oxide from hydrophilic to hydrophobic, as well as induced a surface dipole which can tune the energy levels of metal oxide. The device (0.37 cm^2) with IM showed 7% enhancement in power conversion efficiency (PCE=3.65%) by increasing *Voc* and FF. Moreover, the average performance in large-area device (10.2 cm^2) with IM showed 2 times higher PCE and lower deviation between devices, comparing with the devices without IM, owing to pinhole-free and uniform morphology in active layer.

2PS-249 박형일

High Performance Organic Photovoltaic Cells with Carbon Nanotubes

박형일, 박지선[1], 이주민, 남수아, 김상욱† KAIST: [1]전자부품연구원

Organic photovoltaic cells (OPVs) present the potential to change the market of energy production. Despite promising progress in device performance, PCE have to be enhanced for the commercialization. One of the crucial challenges for the high device performance is the efficient charge transport at the active layer. In this study, we demonstrate an ideal active layer employing various types of carbon nanotubes (CNTs). Unlike previously reported OPVs with CNTs significantly degraded the device performance than those without CNTs. Without charge selectivity, any small proportion of metallic CNTs present may build up undesired pathways for electron-hole recombination. We present the remarkable device performance enhancement in BHJ solar cells employing N- or B-doped CNTs or quantum dot nanoparticle decorated CNTs (QD:CNT) as highly selective electron- or hole-transport enhancement materials. These synergistic effects contribute to a PCE up to 8.6% for PTB7:PCBM BHJ solar cells.

2PS-250 배승환

Effect of Different Charcogenophenes in Isoindigo-based Conjugated Copolymer on Photovoltaic Properties

배승환, 유태웅, 정의혁, 조원호† 서울대학교 재료공학부

New low bandgap conjugated copolymers composed of isoindigo as electron-deficient unit and various chalcogenophenes (thiophene, selenophene and tellurophene) as electron-rich unit were synthesized (as denoted by PIT, PISe and PITe, respectively) to investigate the effect of different chalcogenophene on the photovoltaic properties of isoindigo-based copolymers. The copolymers (PISe and PITe) show bathochromic shift in UV-Vis absorption and lower LUMO energy level as compared to its thiophene analogue (PIT). The solar cell device based on PISe blended with $PC_{61}BM$ exhibits a promising power conversion efficiency (PCE) of 5.72% with a J_{SC} of 10.21 mA cm^{-2}, which is higher than those of PIT (PCE of 3.98% and J_{SC} of 8.34 mA cm^{-2}), while the device based on PITe shows lower J_{SC} and PCE than those of PIT and PISe because of its coarse morphology of the blend.

2PS-251 배우리

유기 박막의 초기 성장하는 동안 분자 배향에 규칙성의 질서-무질서 전이

배우리, 김진형, 조양진, 강상욱† 고려대학교

Photoelectron spectroscopy (PES)을 사용하여 매우 규칙적으로 정렬 된 열분해 흑연 (HOPG)의 표면에서 1,3-bis(*N*-carbazolyl)benzene (mCP) 박막 필름의 최초로 성장하는 동안 분자 배향 식별과 규칙성의 질서-무질서 전이 식별에 관하여 연구를 진행하였다. Independent atomic center approximation(IAC)을 적용하여 양자 역학적으로 계산한 이론상의 PES 진폭은 실험적인 관측과 비교하기 위하여 계산 하였다. 이 방법은 분자 방향의 체계적인 추정과 특이한 구조의 분자에 대한 규칙성의 무질서를 제공한다. 낮은 범위에서, 절연된 흡착의 평형 방향이 추정되었다. 그러나, 적용 범위가 증가함에 따라 각 피크의 라인 폭 증가뿐만 아니라 PES 구조의 변화의 결과로써 흡착물 사이의 상호작용이 지배적으로 되고 규칙성의 무질서가 증가하였다.

2PS-252 배은진

High-Performance Soluble Oxide Gate Dielectrics Prepared Using the Self-Combustion Reaction for Low-Temperature-Processable Thin-Film Transistors

배은진, 강영훈, 이영철, 이창진, 조성윤† 한국화학연구원

We have fabricated high performance metal oxide TFTs with aluminium oxide gate dielectrics based on combustion chemistry by solution process. Combustion reaction provides the high self-generated energy which can be utilized to convert precursors into the corresponding oxides at low temperatures. For the fabrication of low-temperature, solution-based gate dielectric film with proper gate dielectric properties, combustive aluminium precursors with organic ingredients were designed and prepared. In this study, aluminium oxide gate dielectric layers were spin-coated from a solution of aluminium precursors in 2-methoxyethanol and annealed at 250 ℃. Active layers were then spin-coated from ZnO precursors in ammonia. We have investigated structural and morphological properties of aluminium oxide gate dielectrics for metal oxide TFTs fabricated in various processing conditions by scanning electron microscopy, energy dispersive spectroscopy and X-ray diffraction analysis.

2PS-253 백용화

Photo-Curable Polymer Blend Dielectrics for Organic Field-Effect Transistor

백용화, 김경훈, 김세현[1], 박찬언† 포항공과대학교: [1]영남대학교

Polymer blending methods have been widely applied to make various organic electronic devices because beneficial properties of distinct polymers combined in a single composite can be simultaneously provided to the devices from simple and one-step fabrication procedure. We introduce a solution-processable method for preparing photo-curable and -patternable gate dielectrics using blend solutions composed of two discernible polymers: polystyrene (PS) derivatives and poly(melamine-co-formaldehyde)acrylate (PMFA). This polymer blend was found to form smooth films with good electrical stability, solvent resistance, and hydrophobic film surfaces via vertically graded phase separation. The dielectric properties could be controlled by varying the blending ratio of discernible polymers with a photoinitiator, yielding a solution that was subsequently spin-cast and cured by UV irradiation. OFETs based on several semiconductors showed high mobilities and excellent stability.

2PS-254 백장열

New Blue Emitting Materials for Lighting

백장열, 이윤지, 단소풍, 전찬우[1], 황재영[1], 권순기, 김윤희[1]† 경상대학교 고분자공학과: [1]경상대학교 화학과

Organic light-emitting diodes (OLEDs) have attracted attention due to their possible applications. Such as lighting, we were synthesized new compound. New blue emitting materials based on naphthyl anthracene were synthesized by suzuki coupling reaction etc. These compounds were characterized by ^{1}H-NMR, FT-IR and Mass. The obtained blue emitting materials has good thermal stability. The blue emitting materials film state showed maximum emission at 446 nm and 447 nm respectively. This were used as blue dopant material device displayed turn-on at 4.5 V and confirmed the maximum luminous efficiency from 1.38 lm/W (2.59 cd/A at 5.9 V) and 1.37 lm/W (2.56 cd/A at 5.8 V). EL spectra showed maximum luminous wavelength at 456 nm and exhibited CIE coordinate from (0.15,0.14).

2PS-255 백지응

Controlling the threshold voltages of organic thin film transistors with various channel-electrode materials *via* vapor-phased surface-modification

백지응, 임성갑[1]† 카이스트 생명화학공학과 기능성 박막 연구실: [1]KAIST

The threshold voltages of organic thin-film transistors (oTFTs) were easily controlled by modifying the bottom-contact electrodes with an ultrathin polymeric layer deposited

Effect of Different Charcogenophenes in Isoindigo-based Conjugated Copolymer on Photovoltaic Properties

배승환, 유태웅, 정의혁, 조원호*

서울대학교 재료공학부

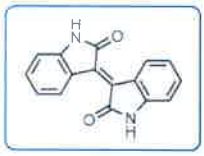
New low bandgap conjugated copolymers composed of isoindigo as electron-deficient unit and various chalcogenophenes (thiophene, selenophene and tellurophene) as electron-rich unit were synthesized (as denoted by PIT, PISe and PITe, respectively) to investigate the effect of different chalcogenophene on the photovoltaic properties of isoindigo-based copolymers. The copolymers (PISe and PITe) show bathochromic shift in UV-Vis absorption and lower LUMO energy level as compared to its thiophene analogue (PIT). The solar cell device based on PISe blended with $PC_{61}BM$ exhibits a promising power conversion efficiency (PCE) of 5.72% with a J_{SC} of 10.21 mA cm^{-2}, which is higher than those of PIT (PCE of 3.98% and J_{SC} of 8.34 mA cm^{-2}), while the device based on PITe shows lower J_{SC} and PCE than those of PIT and PISe because of its coarse morphology of the blend.

Effect of Different Chalcogenophenes in Isoindigo-based Conjugated Copolymer on Photovoltaic Properties

배승환, 유태웅, 정의혁, 조원호*
서울대학교 재료공학부

Introduction

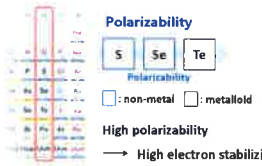
❖ Advantages of isoindigo for high performance organic solar cells (OSCs)



- ✓ High absorption coefficient
- ✓ Two lactam rings with strong electron withdrawing property
  - ⇒ *Deep HOMO energy level*
- ✓ Highly planar π-conjugated structure
  - ⇒ *High hole mobility of OFETs*

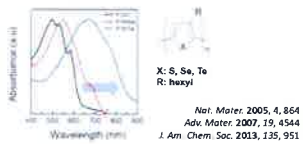
❖ Effects of different chalcogen atoms

✓ Chalcogen atom



High polarizability → High electron stabilizing effect → *Reduced bandgap*

✓ Chalcogenophene



Nat. Mater. 2005, 4, 864
Adv. Mater. 2007, 19, 4544
J. Am. Chem. Soc. 2013, 135, 951

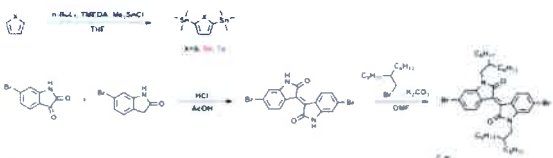
Objectives

- To synthesize alternating conjugated copolymers with isoindigo and different chalcogenophenes and compare the characteristics of synthesized polymers
- To investigate the photovoltaic properties and charge transport properties depending on the change of the chalcogenophenes (thiophene, selenophene and tellurophene)

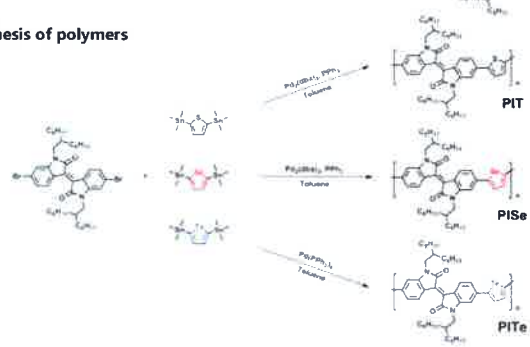
Results

❖ Synthesis of monomers and polymers

✓ Synthesis of monomers

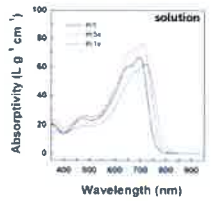


✓ Synthesis of polymers

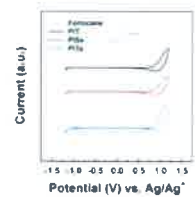


❖ Characterization of polymers

✓ Absorption spectra



✓ Cyclic voltammogram

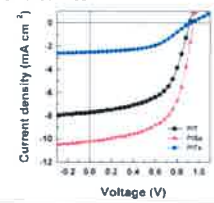


Polymer	M_n (kg mol^{-1})	PDI	λ_{max} (nm) solution	λ_{max} (nm) Film	E_g^{opt} (eV)	HOMO (eV)	LUMO[a] (eV)
PIT	86	1.55	755	765	1.62	−5.60	−3.98
PISe	108	1.51	780	785	1.58	−5.60	−4.02
PITe	47	1.60	800	810	1.53	−5.60	−4.09

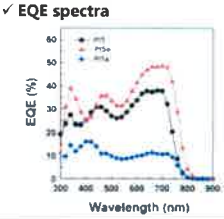
[a] Calculated from the optical bandgap and the HOMO energy level. LUMO=HOMO+E_g^{opt}

❖ Photovoltaic properties

✓ *J–V* curves



✓ EQE spectra

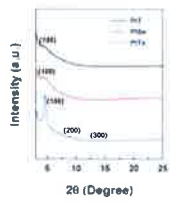


Polymer	Blend ratio (polymer:$PC_{61}BM$ (w/w))	V_{OC} (V)	J_{SC} (mA cm^{-2})	FF (%)	PCE (%)
PIT	1:1	0.91	7.71	57	3.98
PISe	1:1	0.95	10.21	59	5.72
PITe	1:4	0.92	2.51	50	1.16

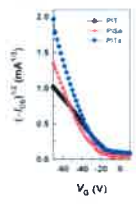
Device configuration: (ITO/PEDOT:PSS/polymer:$PC_{61}BM$ (2.5 vol% DIO in DCB)/Ca/Al)

❖ Crystallinity and FET behavior

✓ XRD



✓ FET

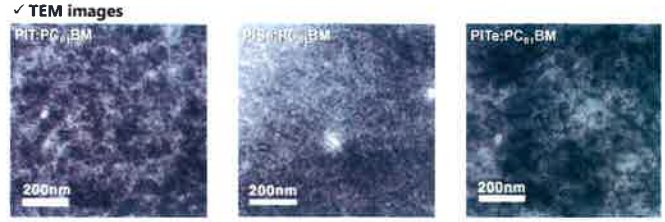


	FET mobility ($cm^2 V^{-1} s^{-1}$)
PIT	0.3×10^{-2}
PISe	1.6×10^{-2}
PITe	7.2×10^{-3}

- PIT → PISe → PITe: crystallinity↑ → FET mobility↑

❖ Film morphology

✓ TEM images



Conclusions

- PISe shows the enhancement of J_{SC} (10.21 mA cm^{-2}) and PCE (5.72%) compared to those of PIT (J_{SC}: 8.34 mA cm^{-2}, PCE: 3.98%).
- PITe exhibits the highest FET hole mobility (0.072 $cm^2 V^{-1} s^{-1}$) due to the highest crystallinity among the synthesized polymers while the lowest PCE is obtained by large phase separation.