Först energy transfer 를 적용한 준고체 DSSC 의 효율향상

*천 종훈, 이 정관, 양 현석,**김 재홍

Enhanced Light Harvesting from Först-type resonance Energy Transfer in the Quasi-Solid State Dye-Sensitized Solar Cells

*Jong Hun Cheon, Jeong Gwan Lee, Hyeon Seok Yang, **Jae Hong Kim

We have demonstrated Först-type resonance energy transfer (FRET) in the quasi-solid type dye-sensitized solar cells between organic fluorescence materials as an energy donor doped in polymeric gel electrolyte and ruthenium complex as an energy acceptor on surface of TiO_2. The strong spectral overlap of emission /absorption of energy donor and acceptor is required to get high FRET efficiency. The judicious choice of energy donor allows the enhancement of light harvesting characters of energy acceptor in quasi-solid dye sensitized solar cells which increase the power conversion efficiency.

The enhanced light harvesting effect by the judicious choice/design of the fluorescence materials and sensitizing dyes permits the enhancement of photovoltaic performance of DSSC.

Key words : Dye-sensitized Solar Cells(염료감응형태양전지), Först-type Resonance Energy Transfer Quasi-solid DSSC, Fluorescence Materials(형광체), Light Harvesting Effeciency

E-mail : *jhcheon@ynu.ac.kr

multi-chromophore를 가지는 유기염료의 DSSC 광전변환거동

*김 명석, 천 종훈, 정 대영, **김재홍

Photovoltaic Properties of Dendritic Photosensitizers containing multi-chromophore for Dye-sensitized Solar Cells.

*MyeongSeok Kim, Jong Hun Cheon, DaeYoung Jung, **JaeHong Kim

Since Gratzel and co-workers developed a new type of solar cell based on the nanocrystalline TiO2 electrode, dye-sensitized solar cells (DSSCs) have attracted considerable attention on account of their high solar energy-to-conversion efficiencies (11%), their easy manufacturing process with low cost production compared to conventional p-n junction solar cells. The mechanism of DSSC is based on the injection of electrons from the photoexcited dye into the conduction band of nanocrystalline TiO2. The oxidized dye is reduced by the hole injection process from either the hole counter or electrolyte. Thus, the electronic structures, such as HOMO, LUMO, and HOMO-LUMO gap, of dye molecule in DSSC are deeply related to the electron transfer by photoexcitation and redox potential.

To date, high performance and good stability of DSSC based on Ru-dyes as a photosensitizer had been widely addressed in the literatures. DSSC with Ru-bipyridyl complexes (N3 and N719), and the black ruthenium dye have achieved power conversion efficiencies up to 11.2% and 10.4%, respectively. However, the Ru-dyes are facing the problem of manufacturing costs and environmental issues. In order to obtain even cheaper photosensitizers for DSSC, metal-free organic photosensitizers are strongly desired. Metal-free organic dyes offer superior molar extinction coefficients, low cost, and a diversity of molecular structures, compared to conventional Ru-dyes. Recently, novel photosensitizers such as coumarin, merocyanine, cyanine, indoline, hemicyanine, triphenylamine, dialkylaniline, bis(dimethylfluorenyl)-aminophenyl, phenothiazine, tetrahydroquinoline, and carbazole based dyes have achieved solar-to-electrical power conversion efficiencies up to 5–9%. On the other hand, organic dye molecules have large π-conjugated planner structures which would bring out strong molecular stacking in their solid-state and poor solubility in their media. It was well known that the molecular stacking of organic dyes could reduce the electron transfer pathway in opto-electronic devices, significantly.

In this paper, we have studied on synthesis and characterization of dendritic organic dyes with different number of electron acceptor/anchoring moieties in the end of dendrimer. The photovoltaic performances and the incident photon-to-current (IPCE) of these dyes were measured to evaluate the effects of the dendritic strucuture on the open-circuit voltage and the short-circuit current.

Key words : Phenothiazine, chromophore, DSSC, Dendritic, Photosensitizer

E-mail : *mr2kms@ynu.ac.kr