Photoinduced Energy and Electron Transfer in Porphyrin-Perylene Dyad Bridged with a Triazine Group

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Multi-pigment donor-acceptor arrays attracted much attention because of their potential photoinduced intramolecular/ intermolecular electron transfer to generate charge-separated states, which determines the material conversion and energy storage in natural photosynthesis process together with the efficiency of artificial molecular photovoltaic systems such as DSSC.(1) Porphyrin-perylene (POR-PDI) systems attracted much attention for their matching absorption of the solar energy.(2) Different linkers would significantly influence the charge recombination and photoinduced electron transfer process.(3)

We will present the synthesis of POR-PDI dyad bridged with a triazine linker and illustrate the energy diagram of POR-PDI dyad. The HOMO energy and LUMO energy of POR are -5.6eV and -3.8eV respectively, and corresponding data of PDI are -5.9eV and -4.4eV respectively,(4) which suggest possibility of the electron transfer from POR to PDI.

Furthermore, we will present the results of absorption and fluorescence determination. Comparison will also be made between the results of synthesized dyad and POR-PDI mixture to illustrate the electron excitation and transfer processes. Absorption spectra of POR-PDI dyad and mixture are identical with the sum of the spectra of compound POR and PDI, indicating that that there was no appreciable intermolecular and intramolecular interaction between the ground-states of POR moiety and PDI moiety. Fluorescence spectra illustrated that intramolecular photoinduced energy transfer takes place in POR-PDI dyad from excited PDI moiety to the POR moiety when excited at 491 nm, whilst efficient intramolecular photoinduced electron transfer occurs from excited POR moiety to the PDI moiety as exciting at 423nm leading to an obvious fluorescence quench (Figure 1).

The kinetic analysis via transient fluorescence spectra indicated that there occur fast photoinduced electron transfer and low charge recombination, which are good indications that POR-PDI dyad has the potential to increase the solar-electric conversion efficiency in DSSCs.

Finally, we will make a comparison of kinetics of electron transfer among different POR-PDI systems and other donor-acceptor dyads with a triazine linker.

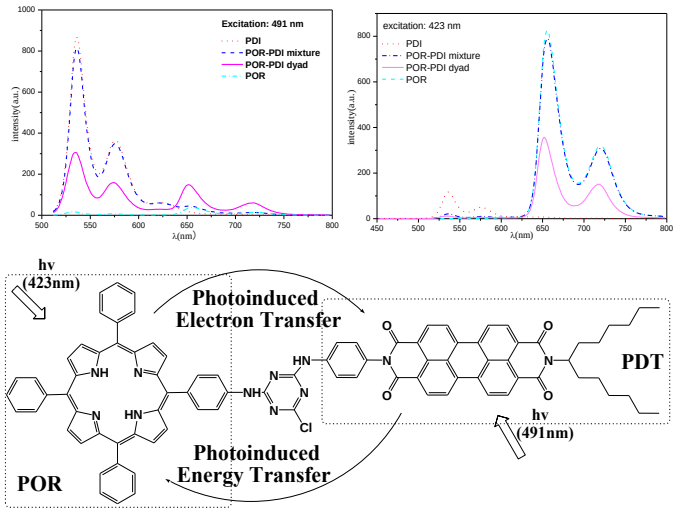

Figure 1. Fluorescence spectra and the photoinduced energy and electron transfer process within POR-PDI dyad.

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References

(1) (a) Jime´nez, A.-J.; Spa1nig, F.; Salome´ Rodrı´guez-Morgade, M.; Ohkubo, K.; Fukuzumi, S.; Guldi, D.-M.; Torres, T. *Org. Lett.,* **2007**, *9*, 2481. (b) D'Souza, F.; Smith, P.-M.; Zandler, M.-E.; McCarty, A.-L.; Itou, M.; Araki, Y.; Ito, O. *J. Am. Chem. Soc.*, **2004**, *126*, 7898.

(2) (a) Ghirotti, M.; Chiorboli, C.; You, C.-C.; Würthner, F.; Scandola, F. *J. Phys. Chem. A*, **2008**, *112,* 3376. (b) Prathapan, S.; Yang, S.-I.; Seth, J.; Miller, M.-A.; Bocian, D.-F.; Holten, D.; Lindsey, J.-S. *J. Phys. Chem. B*, **2001**, *105,* 8237.

(3) (a) Wasielewski, M.-R. C*hem. Rev.*, **1992**, *92,* 435. (b) Tao, M.; Liu, L.; Liu, D.; Zhou, X. *Dyes Pigments*, **2010**, *85*, 21.

(4) Nakamura, J.; Suzuki, S.; Takahashi, K.; Yokoe, C.; Murata, K. *Bull. Chem. Soc. Jpn.*, **2004**, *77*, 2185.