Electronic Supplementary Information

A photoluminescent layer for improving performance of dye-sensitized solar cell

Tzu-Hui Wang[a], Tzu-Wei Huang[a], Yu-Chen Tsai[a*], Ya-Wen Chang[b], and Chien-Shiun Liao[b]

[a]Department of Chemical Engineering, National Chung Hsing University, 250, Kuo Kuang Road, Taichung 402, Taiwan.

[b]Department of Chemical Engineering and Materials Science, Yuan Ze University.135, Yuan-Tung Road, Chung-Li, Taoyuan 320, Taiwan.

* Corresponding author. Tel.: +886-4-22857257; Fax: +886-4-22854734

E-mail address: yctsai@dragon.nchu.edu.tw

Experimental details

Reagents. Pyrene and EVA were obtained from Aldrich. N719 dye was purchased from Solaronix. TiO_2 paste (NN-TiO_2), Pt paste (PtSP), and electrolyte were purchased from Ruilong (Taiwan). The reagents were used as purchased without any further pretreatment.

Apparatus. AFM images were obtained using a SPA-400 (Seiko, Japan). *J-V* characteristics were measured with a Keithley 2400 source meter under illumination from a solar simulator composed of a 500 W Xe lamp and an AM 1.5 filter (Oriel).

Light intensity was calibrated with a silicon photodiode. Absorption spectrum was measured with a Lamda-25 (Perkin Elmer, USA). Photoluminescence spectrum of pyrene was performed with a fluorescence spectrometer (LS55, Perkin Elmer, USA). The quantum yield of pyrene was determined by using coumarin-1 (0.99 in ethyl acetate) as the reference by the literature method[1]. FESEM image was obtained using a JSM-6700F (JEOL, Japan). IPCE experiments were carried out at Advanced Laboratory of Accommodation and Research for Organic Photovoltaics, Taiwan.

Preparation of the DSSCs. TiO_2 paste was coated onto FTO glass substrates (Solaronix) by using a screen printing technique and annealed at 500 ^oC for 30 min in the air to form a TiO_2 film. The above prepared photoelectrode had a 0.16 cm^2 active area which was immersed in ethanol containing 0.5 mM N719 dye for 48 h. Pt paste was coated onto FTO by a screen printing technique and heated at 400 ^oC for 30 min as the counter electrode. The DSSCs were sealed with sealing material, SX1170 (Solaronix). The pyrene photoluminescent layer was coated on the front side of DSSC by drop casting of pyrene solution (0.05-1.6 wt% in ethanol solution) onto front surface of DSSC and heated at 40 ^oC for 10 min. Finally, EVA was coated on the top of pyrene photoluminescent layer by drop casting of EVA solution (0.1 wt% in ethanol solution) on the top of pyrene photoluminescent layer and heated at 40 ^oC for

10 min.

Additional results

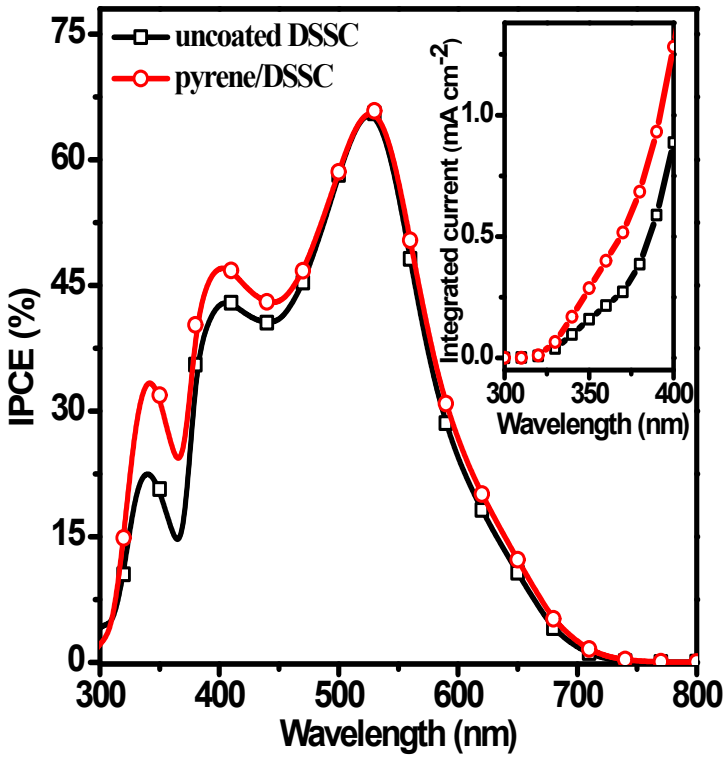

Fig. S1. IPCE spectra of uncoated DSSC and pyrene/DSSC. The inset shows the integrated current spectra of uncoated DSSC and pyrene/DSSC in the wavelength range of 300~400 nm.

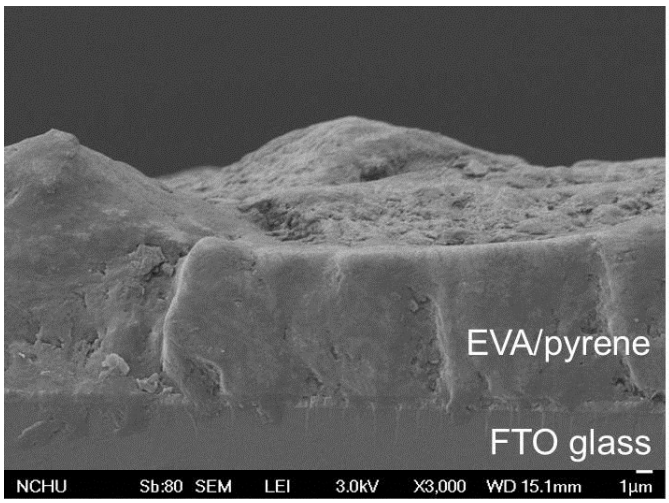

Fig. S2. Cross-sectional FESEM image of EVA/pyrene/FTO glass.

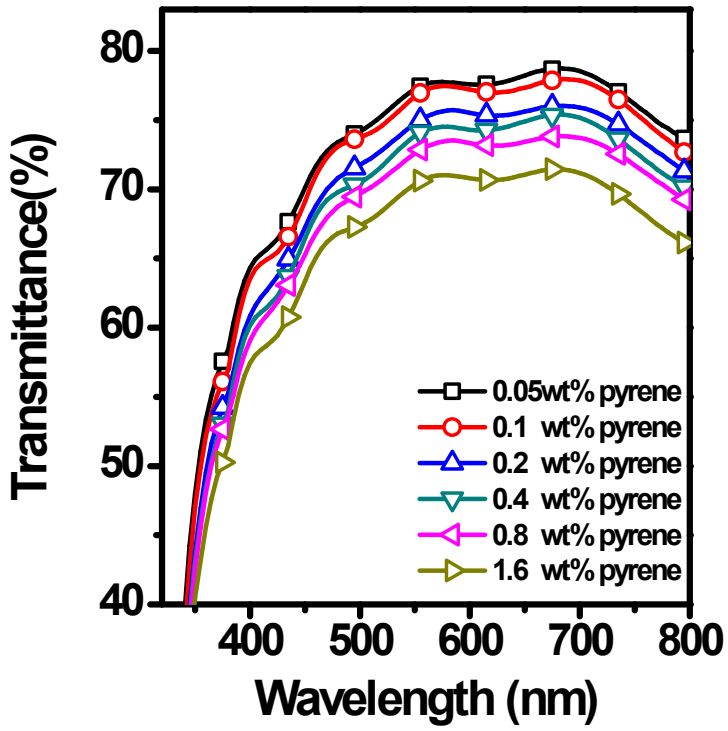

Fig. S3. Transmittance spectra of EVA/pyrene/FTO glass with six different amount of pyrene photoluminescent layers.

Reference

1. A. M. Brouwer, Pure Appl. Chem., 2011, **83**, 2213-2228.