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Electronic Supplementary Information (ESI)

Enhancing outdoor stability of dye-sensitized solar cells by the spectrum conversion layer with 1,8-naphthalimide derivatives

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(a)



Fig. S1. (a) General synthetic route and numbering (b) representative formula of 1,8-naphthalimide derivatives; Family of derivatives are synthesized by the reaction of 1,8-naphthalic anhydride (6,7-dimethoxy-benz[*de*]isoquinolin-1,3-dione) with kinds of alkyl amines. Representative formula is (2-(1-ethylhexyl)-6,7-dimethoxy-benz[*de*]isoquinolin-1,3-dione), CAS No. 139106-96-0, Molecular Formula C₂₂N₂₇NO₄ and Molecular Weight 369.45 g/mole



Fig. S2. Transmittances of TiO_2 sol coated FTO glasses; TiO₂ sol was coated 1, 2 and 3 times on FTO glasses as a reference UV

absorbing materials, corresponding to TiO_2 sol #1, #2 and #3, respectively.



Fig. S3. Reflectances of SCL and TiO₂ sol coated FTO glasses;
The concentration of 1,8-naphthalimide derivatives was 2 wt.% for SCL [2.0] and the number TiO₂ sol coating was 3 times for TiO₂ sol #3.



Fig. S4. Absorbances of SCL and TiO₂ sol coated FTO glasses;
The concentration of 1,8-naphthalimide derivatives was 2 wt.% for SCL [2.0] and the number TiO2 sol coating was 3 times for TiO2 sol #3. Absorbance was calculated from the transmittance and reflectance.



Fig. S5. Cross-section of SCL coated on the FTO glass by scanning electron microscope (SEM) after pretreatment using liquid nitrogen for rapid cooling.



Fig. S6. Transmittance and reflectance of commercial UV cut-off filer;



Fig. S7. Difference of photo-conversion efficiency of DSSCs with SCL and bare DSSC. The concentration of 1,8-naphthalimide derivatives was 2 wt.%.