High Performance Organic Sensitizer of DSSCs under Indoor Light and Low Cost Hole-transporting Materials in doped-free p-i-n Perovskite Solar Cells

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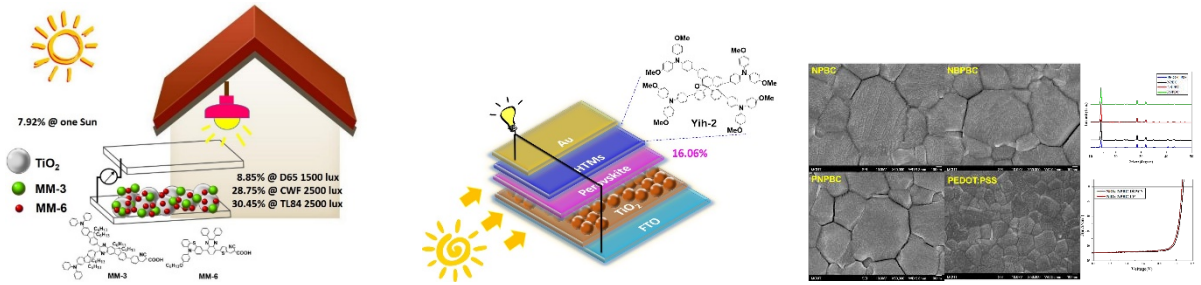
The new dyes **MM-5** and **MM-6** were found to perform remarkable efficiency in light-harvesting either under sunlight or under indoor light. Through co-sensitization of **MM-3** and **MM-6**, the DSSCs exhibited a PCE of 7.92% under one sun (AM 1.5G) illumination, and 27.76%, 28.74% and 30.45%, respectively, under 600 lux, 1000 lux and 2500 lux indoor light using a TL84 fluorescent lamp. The high performance that was achieved by mixing **MM-3** and **MM-6** can be partly ascribed by a better dye-coverage on the TiO_2 surface.

We produced and tested novel D–A–D HTMs with spiro linkage in PSCs. The acceptor structure of spiro[fluorene-9,9′-phenanthren-10′-one] in **Yih**-series HTMs was facile, inexpensive (29.14~29.57 US$/g), and high yield. Consequently, **Yih-2** as an HTM in PSCs achieved a J_{sc} of 22.18 mA·cm^{-2}, V_{oc} of 1.02 V, and fill factor of 0.71, corresponding to an overall conversion efficiency of 16.06%, similar to that of **spiro-OMeTAD** (16.08%).

Highly efficient and stable semi-transparent perovskite photovoltaic cells are realized by using p-i-n device structure ITO/NiO_x/HTM/perovskite/$PC_{61}BM$/BCP/Ag using the 3,3'-bicarbazoles-based **NP-BC** as the interfacial layer between NiO_x and perovskite layer. The internal layer improved the grain size of perovskite layer, also enhanced the circuit current (J_{SC}) and fill factor (FF), the best performance near 20% under AM 1.5 condition, which is comparable to that using bare NiO_x showed the efficiency of 16.11%.



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