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Dye-Sensitized Solar Cells: Interfacial Nano-engineering and Structural Design for High Photo-conversion Efficiency

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Low-cost dye-sensitized solar cell has attracted much attention thanks to unique characteristics of transparency and various colors. Dye-sensitized solar cell is composed of dye-coated nanocrystalline wide band-gap semiconductor, redox electrolyte and platinum counter electrode. Transparency and various colors are attributed to 10-20 μm-thick semiconductor film comprising particle size of about 20 nm and difference in HOMO-LUMO energies of dye molecules, respectively. Biomimetic working principle enables electron injection and regeneration effectively. Recent researches for dye-sensitized solar cell have been focused on improvement of solar-to-electricity conversion efficiency. The photovoltaic performance is dependent on material geometry, film structure and interface between materials, therefore careful design of materials and film structure and manufacturing process are required. Here we report on high efficiency dye-sensitized solar cell based on interfacial engineering for suppression of recombination and optical design for enhancement of light scattering as well as optimal manufacturing process. On the basis for improvement of photovoltaic performance, Transient photocurrent-voltage spectroscopy, IPCE, EIS are studied to understand electron transport and recombination behavior, wavelength-dependent external quantum efficiency and interfacial charge transfer, respectively.