Supplementary Material

Improved charge separation and transport efficiency in panchromatic sensitized solar cells with co-sensitization of PbS/CdS/ZnS quantum dots and dye molecules

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1. Electrochemical impedance spectroscopy (EIS)

Electrochemical Impedance Spectroscopy (EIS) was obtained using a CHI650C Electrochemical Workstation (Shanghai Chenhua, China) under dark with a magnitude of the modulation signal of 5 mV, ranging from 1 MHz to 0.1 mHz. The spectra were fitted by Z-View software in terms of appropriate equivalent circuits.

Impedance spectroscopy measured in the dark is a well-known technique to study the charge-transfer processes of solar cells. In general, Nyquist plots consist of three semicircles, with the leftmost one occurring at high frequencies and representing the redox charge transfer at the interface between platinum counter electrode and electrolyte, the middle one at intermediate frequencies representing recombination at the TiO_2/electrolyte interface via which recombination resistance can be read through the diameter, and the rightmost one at low frequencies reflecting ion diffusion in the electrolyte, [1, 2] In EIS spectra, the rightmost one often overlaps with the mid-frequency peak. EIS can give recombination resistance (R_{ct}), which equals nearly to the diameter of the second semicircle. Nearly two semicircles were observed from Fig. S1. As can be seen, the second semicircle's diameter of the Nyquist plot from TiO_2/PbS/CdS/ZnS/N719 based solar cells is much larger than that from TiO_2/PbS/CdS/ZnS based solar cells, which means the recombination was depressed by co-sensitization with dye N719.

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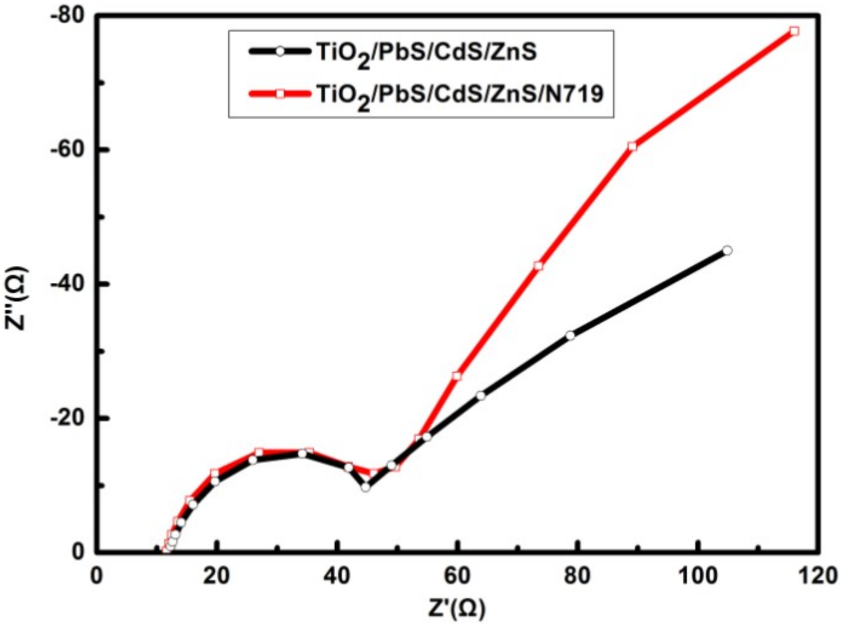

Figure S1. Typical electrochemical impedance spectra of cells in the forms of Nyquist plots. The spectra were measured with an external potential of -0.7V in the dark.

References

1. J. Bisquert, Phys. Chem. Chem. Phys., 2000, 2, 4185-4192.

2. J. Bisquert, J. Phys. Chem. C, 2002, 106, 325-333.