Supporting Information

ZnOHF Nanostructure-Based Quantum Dots-Sensitized Solar Cells

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1. Experimental detail

**Preparation**

The electrodeposition of ZnOHF nanostructures was carried out in a two-electrode cell and the working electrode was ITO glass with a sheet resistance of 15 Ω. A piece of pure zinc sheet was used as counter electrode. The aqueous electrolyte contained 0.05 M Zn(NO₃)₂ and 0.1 M KF. Temperature was fixed at 60 °C and electrodeposition was carried out under potentiostatic condition 0.4 V vs. counter electrode. The electrodeposition duration varied from 5 s to 3 min.

ZnO HR was also electrodeposited in the two-electrode cell, but the electrolyte just contained 0.005 M Zn(NO₃)₂. The electrodeposition temperature, potential and duration were set at 75 °C, 0.7 V and 30 min respectively. Since our goal was to electrodeposits ZnO HR with the similar film thickness to ZnOHF (1 min), the concentration of Zn(NO₃)₂ and other conditions were different from those used for the electrodeposition of ZnOHF nanostructures.

ZnOHF nanostructures, ZnO HR and ITO glass were co-sensitized with CdS and CdSe QDs by SILAR method. First, these samples were sensitized with CdS QDs by SILAR that involved the successive immersion in the aqueous solutions of 0.05 M Cd(NO₃)₂, water, 0.05 M Na₂S and water for 30 s and this procedure was repeated 30 times. Then, the CdS QDs-sensitized nanostructures were dipped into the ethanol solution of 0.5 M Cd(NO₃)₂ for 5 min at room temperature and then immersed into aqueous solution of Na₂SeSO₃ that was for 1 h at 50 °C, followed by rinsing with DI water and drying with an drier. The procedure was repeated 4 times.  

CdS/CdSe co-sensitized nanostructures were coated with ZnS by SILAR method. They were first immersed in the ethanol solution of 0.5 M Zn(NO₃)₂ for 5 min, rinsed with DI water, and dried with the drier. Then, they were dipped the aqueous solution of 0.5 M Na₂S for 5 min, followed by rinsing with DI water and drying with the drier. The procedure was repeated 1 time.

**Characterizations**

X-ray diffraction (XRD) patterns were recorded on a Rigaku D/Max-RB diffractometer with monochromatized Cu Ka radiation (k = 1.5418). The field-emission gun scanning electron microscope (FESEM, Apollo 300) with an energy dispersive X-ray (EDX) spectroscopy system was used to evaluate the morphology and elemental composition of the samples. Transmission electron microscope (TEM, JEM-2100F) was used to evaluate transmission electron microscopy images of the samples.

UV-Vis diffuse reflectance spectra were recorded on a GBC spectrometer (Cintra 10e) equipped with an integrating sphere attachment in the wavelength range of 200-800 nm.  

A two-electrode photoelectrochemical cell was used to study the photoelectrochemical performance of QDSCs. The aqueous solution containing 2 M Na₂S and 3 M S was used as electrolyte and Cu₂S as counter electrode. The Cu₂S counter electrode was prepared by simply immersing pure Cu sheet in the polysulfide electrolyte. A xenon lamp (500 W) with the illumination intensity of ~ 100 mW·cm⁻² and wavelength range of 380-700 nm was used as a light source. A CHI 600A electrochemical analyzer was employed to record the current and voltage obtained under illumination with an active area of 0.25 cm².

2. Supplemental Results
Figure S1. Top view and cross-section view of the ZnO HR electrodeposited in the aqueous electrolyte containing 0.005 M Zn(NO$_3$)$_2$.

Figure S2. UV-Vis absorption spectra of (a) ZnOHF nanostructures and (b) ZnO HR. Compared with ZnO, ZnOHF exhibits larger band gap.

Figure S3. EDX spectrum of CdS/CdSe QDs co-sensitized ZnOHF nanostructures.

Supplemental References: