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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 $Zn(NO_3)_2$ and 0.1 M KF. Temperature was fixed at 60 ℃ 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 $Zn(NO_3)_2$. The electrodeposition temperature, potential and duration were set at 75 ℃, 0.7 V and 30 min respectively. Since our goal was to electrodeposit ZnO HR with the similar film thickness to ZnOHF (1 min), the concentration of $Zn(NO_3)_2$ 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 $Cd(NO_3)_2$, water, 0.05 M Na_2S 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 $Cd(NO_3)_2$ for 5 min at room temperature and then immersed into aqueous solution of Na_2SeSO_3 that was for 1 h at 50 ℃, followed by rinsing with DI water and drying with an drier. The procedure was repeated 4 times [1].

CdS/CdSe co-sensitized nanostructures were coated with ZnS by SILAR method. They were first immersed in the ethanol solution of 0.5 M $Zn(NO_3)_2$ for 5 min, rinsed with DI water, and dried with the drier. Then, they were dipped the aqueous solution of 0.5 M Na_2S for 5 min, followed by rinsing with DI water and drying with the drier. The procedure was repeated 1 time [1].

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 Na_2S and 3 M S was used as electrolyte and Cu_2S as counter electrode [2]. The Cu_2S 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 $mW \cdot cm^{-2}$ 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 cm^2.

2. Supplemental Results

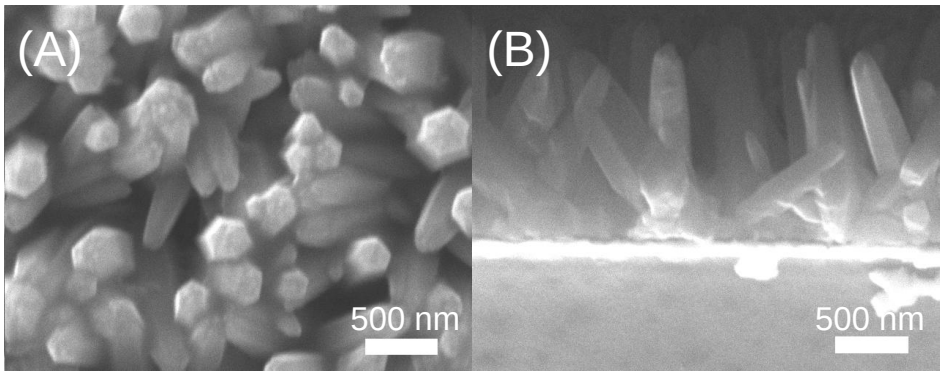

Figure S1. Top view and cross-section view of the ZnO HR electrodeposited in the aqueous electrolyte containing 0.005 M $Zn(NO_3)_2$.

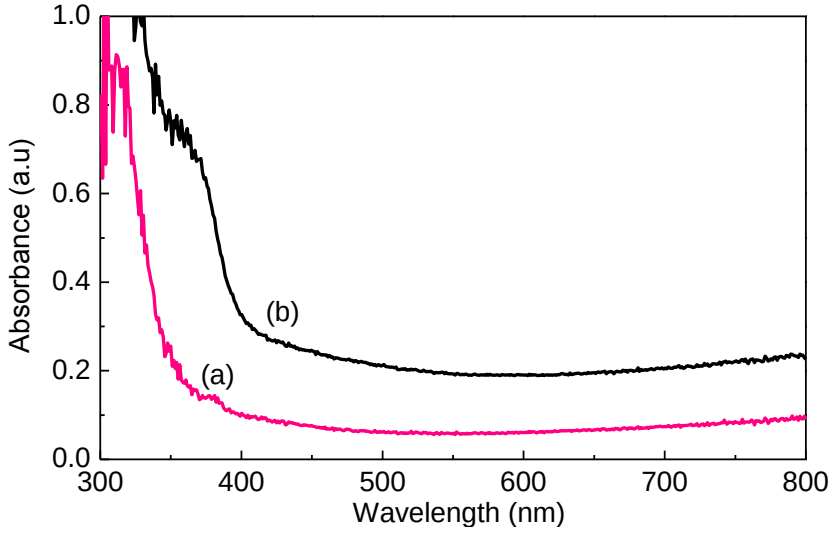

Figure S2. UV-Vis absorption spectra of (a) ZnOHF nanostructures and (b) ZnO HR. Compared with ZnO, ZnOHF exhibits larger band gap.

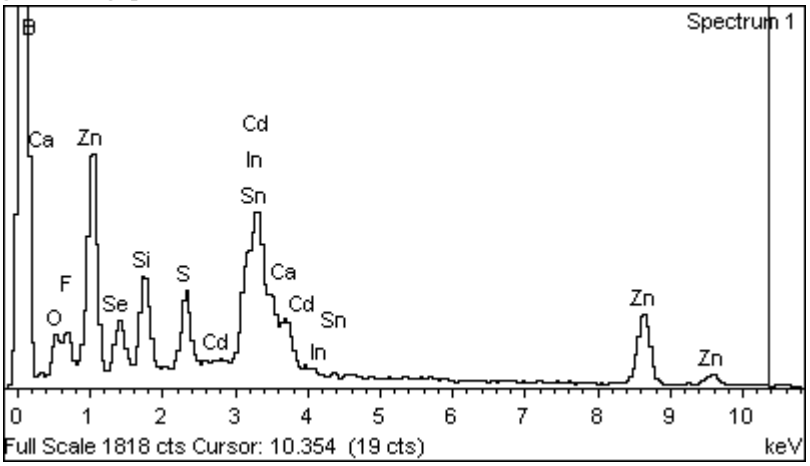

Figure S3. EDX spectrum of CdS/CdSe QDs co-sensitized ZnOHF nanostructures.

Supplemental References:

1. Z. Yang, C. Chen, C. Liu and H. Chang, *Chem. Commun.*, 2010, 46, 5485-5487.
2. S. Biswas, M. F. Hossain and T. Takahashi, *Thin Solid Films*, 2008, 517, 1284-1288.