Supporting Information

Bilayer Quantum Dot-decorated Mesoscopic Inverse Opals for High Volumetric Photoelectrochemical Water Splitting Efficiency

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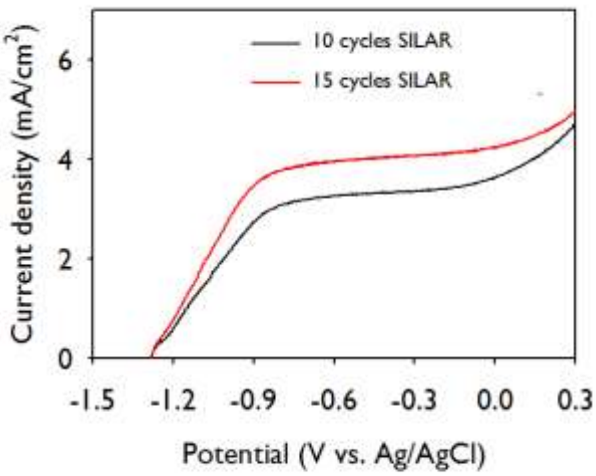

Fig. S1. Current-voltage curves of the CdS meso-IO TiO_2 with various thickness of CdS layer under the illumination of the AM1.5G solar light.

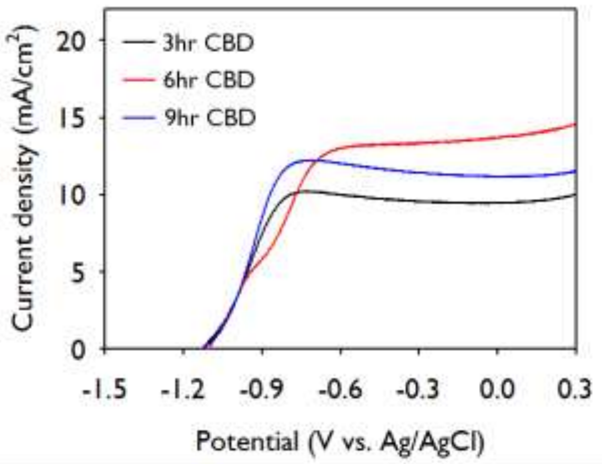

Fig. S2. Current-voltage curves of the CdSe/CdS meso-IO TiO_2 with various thickness of CdSe layer under the illumination of the AM1.5G solar light.

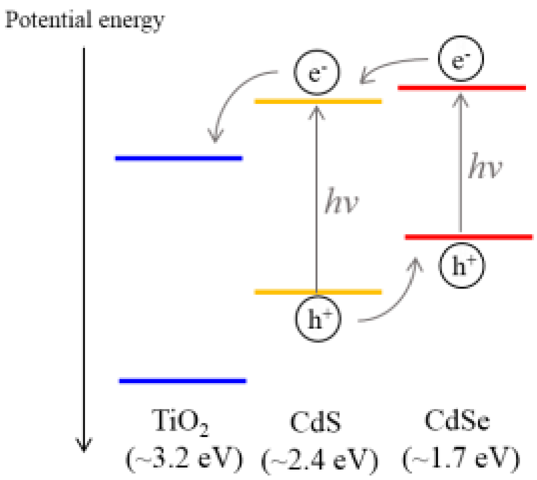

Fig. S3. Schematic diagram of the electron-hole transport in the CdSe/CdS/TiO_2 heterojunction structures.

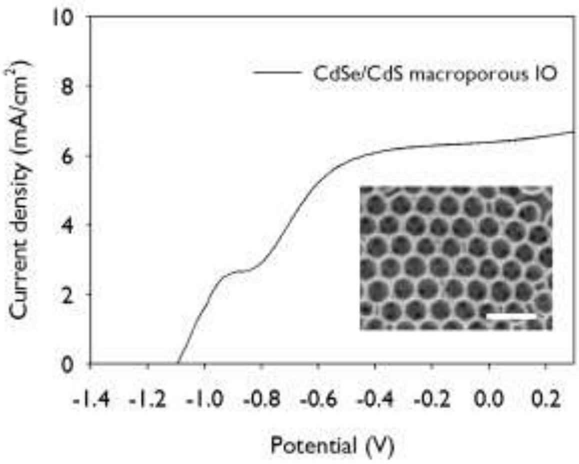

Fig. S4. (a) Current-voltage curves of CdSe/CdS macroporous IO TiO2 film under 1 sun illumination (AM 1.5G). The pore diameter and thickness of the macroporous IO film (see the inset, scale bar: 500 nm) was approximately 200 nm and 6 μm, respectively.

Table S1. PEC photocurrent density of various IO structures

Component of inverse opal structure	Pore size	Photocurrent density (mA/cm^2)
graphene / Fe_2O_3[1]	780nm	3.7 @0.5V vs. Ag/AgCl
Fe_2O_3[2]	810nm	3.1 @0.15V vs. Ag/AgCl
CdS/TiO_2[3]	270nm	4.84 @0V vs. Ag/AgCl
ZnO nanobushes/CdS TiO_2[4]	300nm	6.2 @0V vs. Ag/AgCl
Au nanoparticles/TiO_2[5]	350nm	0.8 @0.5V vs. Ag/AgCl

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Table S2. Photocurrent density, thickness and volumetric current density quantum-dot-sensitized metal oxide structures.

Structure	Current density (mA/cm^2)	Thickness (μm)	Volumetric current density ($mA/cm^2 \cdot \mu m$)
CdS-sensitized TiO_2 inverse opal	4.84	10	0.484
CdSe-sensitized textured porous ZnO[6]	4.3	6	0.52
CdS/ZnO urchinlike hierarchical structure[7]	12	2.5	4.8
ZnO-CdSSe-core-shell nanowire arrays[8]	6	10	0.6
PbS/CdS/TiO_2 heterostructure[9]	6	12	0.5
CdSe/CdS/ZnO 3D nanostructures[10]	17.5	15	1.75
WO_3/W:$BiVO_4$ core/shell nanowires[11]	3.1	2.5	1.24
CdS quantum dot sensitized Si/ZnO hierarchical structure[12]	0.9	70	0.012
TiO_2 nanotube arrays/Ag_2S[13]	0.84	4.1	0.21
WO_3/Mo doped $BiVO_4$ bilayers[14]	1.7	2.1	0.81
This study (CdSe/CdS bilayer meso inverse opal TiO_2)	13.67	7	1.95

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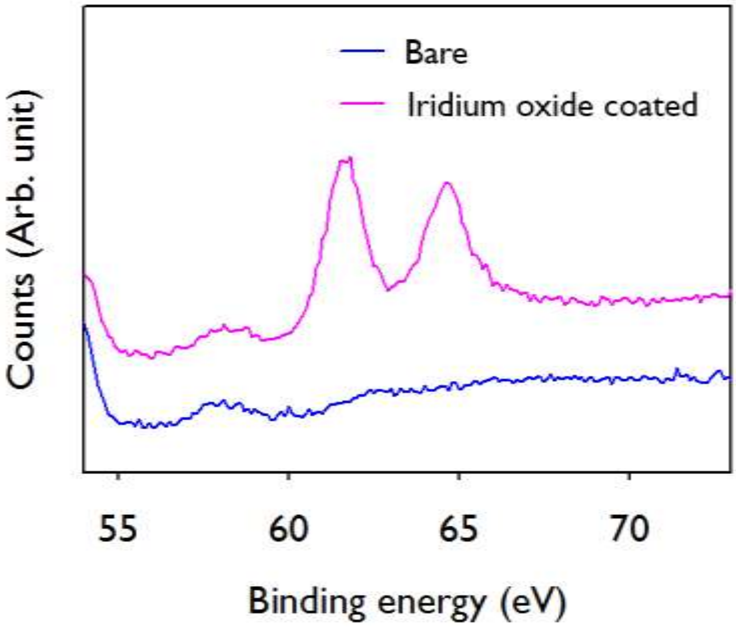

Fig. S5. Iridium XPS spectra of $CdSe/CdS/TiO_2$ and iridium oxide particle-coated $CdSe/CdS/TiO_2$. The strong double peaks are originated from *Ir* $4f_{7/2}$, *Ir* $4f_{5/2}$, and *Ir* $5p_{1/2}$. [15] The quantity of *Ir* was 3 at.%.