Supplementary Material (ESI) for Journal of Materials Chemistry

Block copolymer templated nanoporous TiO_2 for quantum-dot-sensitized solar cells

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Supporting materials

1 Surface area measurements

The surface area and pore size distribution of the PS-b-PEO block copolymer template porous TiO_2 samples were analysized by nitrogen adsorption/desorption isotherm on a Belsorp II adsorption measurement apparatus (BEL Japan, inc.). Since it is difficult to measure the surface area and pore size of the film samples, here we measured the TiO_2 powder prepared using the similar process with the porous TiO_2 films. The samples with titania to polymer ratio of 0.5:1, 1:1, 2:2, and 3:1 were prepared and analysized. The following figure (Fig. S1) shows the nitrogen adsorption/desorption isotherm of different TiO_2 samples.

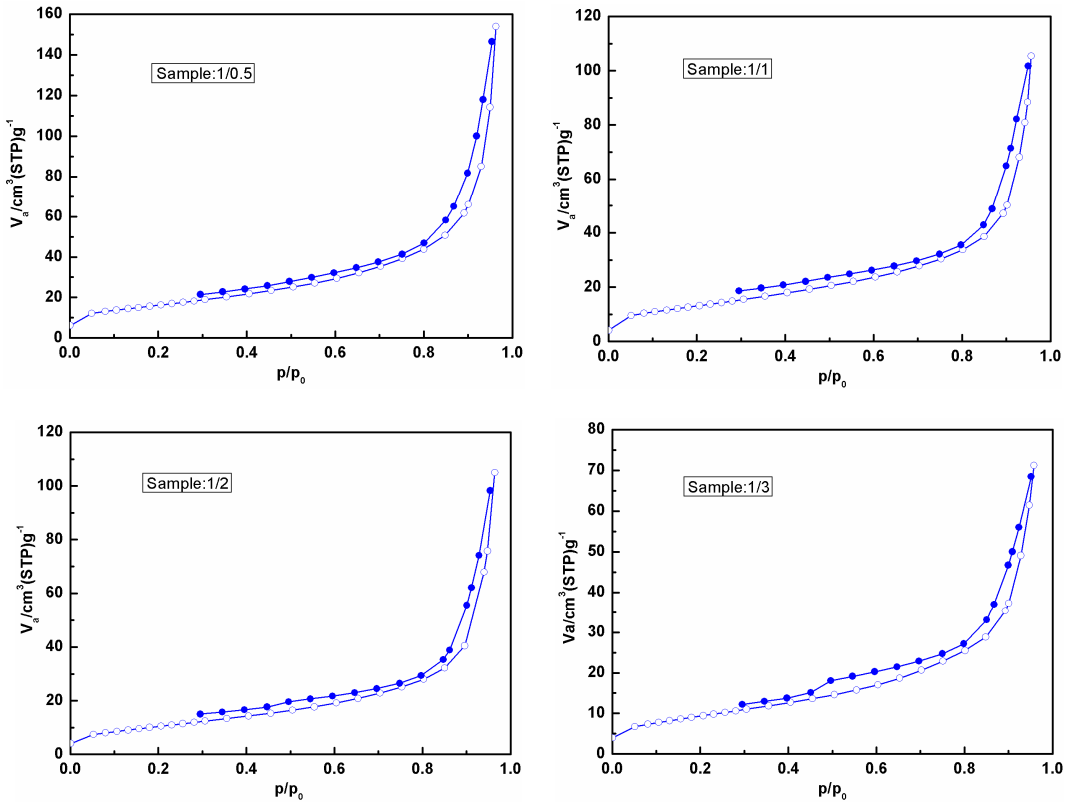


Fig. S1 nitrogen adsorption/desorption isotherm of the TiO_2 samples prepared with different titania/polymer ratio

The specific surface areas of the samples were analysized by Brunauer-Emmett-Teller (BET) method based on the nitrogen adsorption/desorption isotherm. The pore size distribution was analysized by the Barrett-Joiner- Halenda (BJH) method. Fig. S2 and S3 show the surface area, pore volume, and pore size distribution of different samples. The specific surface area of TiO_2 prepares with titania to polymer ratio of 0.5:1, 1:1, 2:1, and 3:1 is 58.52, 48.11, 38.98, and 34.35 m^2/g, respectively. Obviously, the surface area decreases with the increase of titania in the precursor. All the samples seem to show a pore size distribution peak at about 11 nm, which is smaller than that observed from SEM image. But we can see that the pore volume has a similar trend with that of surface area with the change of titania/polymer ratio of the precursor. Considering these results are obtained by powder system, it's safe to conclude that the surface area of the particular film prepared with titania to polymer ratio of 0.5:1 will decrease. So it is reasonable that the TiO_2 film with network microstructure prepared with titania to polymer ratio of 1:1 shows largest surface area and the largest amount of QDs absorption, as a result, the strongest light absorption.

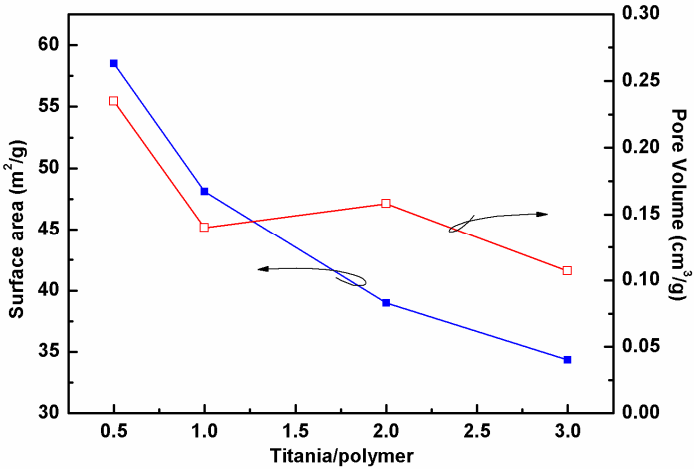


Fig. S2 The specific surface area and pore volume of the TiO_2 samples prepared with different titania/polymer ratio

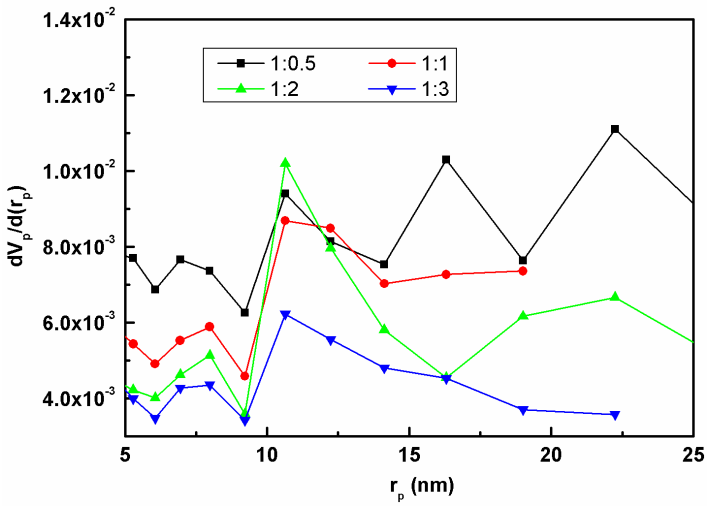
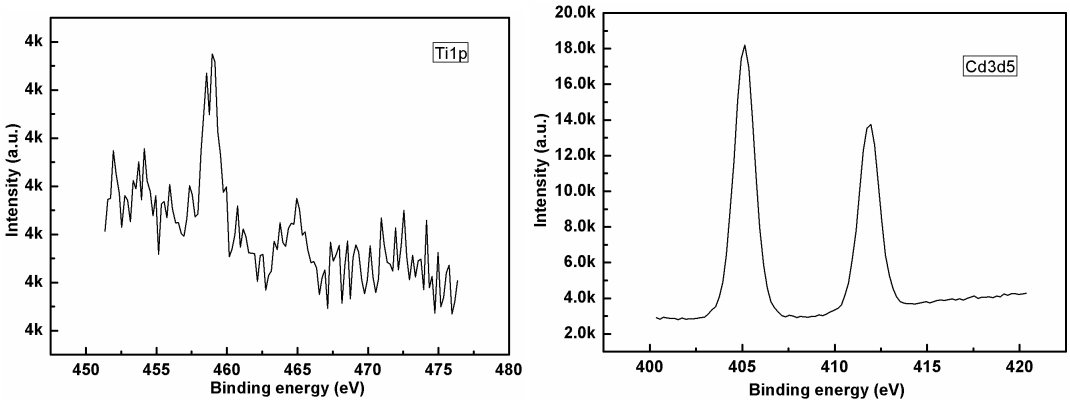


Fig. S3 The pore size distribution of the TiO_2 samples prepared with different titania/polymer ratio.

2 X-ray photoelectron spectra

The X-ray photoelectron spectroscopy (XPS) analysis of the CdS and CdSe QDs co-sensitized porous TiO_2 photoanode was carried out on a Quantum 2000 scanning ESCA microprobe system (Physical Electronics, Inc.). Fig. S4 show the XPS spectra of the Ti, Cd, S, and Se elements. The XPS results indicate the co-existence of CdS and CdSe QDs on the TiO_2 photoanode. Since the CdS QDs are covered by the CdSe QDs, we can not determine the exact ratio of the amount of CdS QDs and CdSe QDs. But we can control the amount of the QDs by controlling the number of circles of CdS QDs deposition and the deposition time of CdSe QDs.



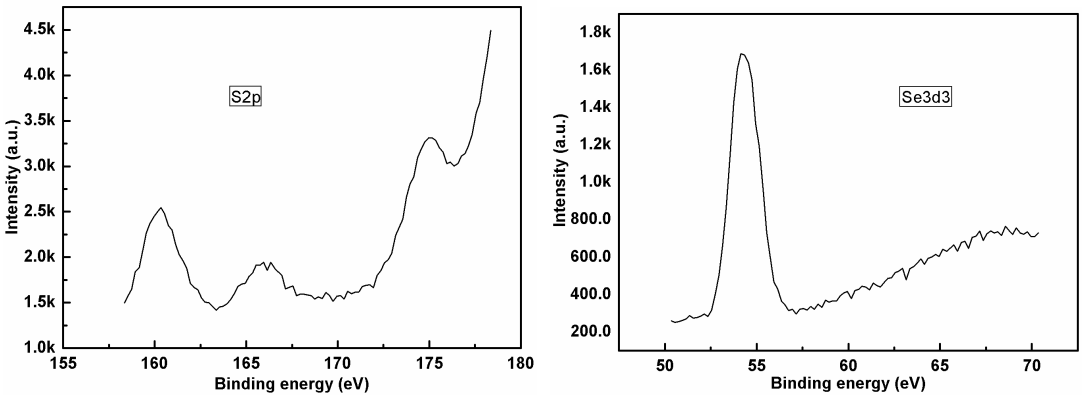


Fig. S4 The XPS spectra of the Ti, Cd, S, and Se elements of the CdS and CdSe QDs co-sensitized porous TiO_2 photoanode.