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Co-sensitization of quantum dot sensitized solar cells composed of TiO_2 nanocrystalline photoanode with CdS and PbS nanoparticles and effect of PbS on the performance of solar cells

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Abstract

In this research, CdS and PbS quantum dots were applied as the light sensitizers in TiO_2 based nanostructured solar cells. The PbS quantum dots could absorb a wide range of the sunlight spectrum on earth due to their low bandgap energy. As a result, the cell sensitization is more effective by application of both CdS and PbS quantum dots sensitizers. The TiO_2 nanocrystals were synthesized through a hydrothermal process and deposited on FTO glass substrates as the photoanode scaffold. Then PbS quantum dots were grown on the surface of this nanocrystalline layer by a successive ionic layer adsorption and reaction (SILAR) method. The CdS quantum dots were over-grown in the next step through a similar deposition method. Finally this sensitized layer was applied as the photoelectrode of the corresponding quantum dot sensitized solar cells. The results demonstrated that the maximum efficiency was achieved for the cell with a photoanode made of co-sensitization through 2 and 6 cycles of PbS and CdS deposition, respectively. The photovoltaic parameters of this cell were measured as Jsc of 10.81 mA/cm^2, Voc of 590 mv and energy conversion efficiency of 2.7±0.2%.

Keywords: solar cells, PbS quantum dots, TiO_2 nanoparticles

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