Original Paper

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Highly efficient, PbS:Hg quantum dot–sensitized, plasmonic solar cells with TiO2 triple-layer photoanode

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Abstract

Highly efficient, PbS:Hg quantum dot–sensitized, plasmonic solar cells with TiO2 triple-layer photoanode were fabricated by successive ionic layer adsorption and reaction (SILAR) method. These nanostructured photoanodes were characterized by optical and morphological techniques and the solar cells were characterized by optical and electrical techniques. The light absorption by the photoanode was enhanced by effective light scattering process using a triple-layer TiO2 nanostructure, fabricated with a TiO2 nanofiber layer sandwiched between two TiO2 nanoparticle layers. The best plasmon-enhanced quantum dot–sensitized solar cell showed an efficiency of 5.41% with short circuit current density of 18.02 mA cm−2 and open-circuit voltage of 679.83 mV. The overall efficiency and photocurrent density of the Q-dot-sensitized solar cell are enhanced by 15.84% and 38.83% respectively due to the plasmonic effect. The enhanced efficiency appears to be due to the improved short circuit current density by increased light absorption by the triple-layered photoanode nanostructure as well as by the localized surface plasmon resonance (LSPR) effect of the plasmonic gold nanoparticles. This is the first report on plasmon-enhanced, triple-layered TiO2 photoanode sensitized with PbS:Hg Q-dots.