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ENHANCING THE PHOTOCURRENT BY TiO_2 NANOFIBERS IN PbS QUANTUM DOT – SENSITIZED SOLAR CELLS

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Semiconductor quantum dots have attracted extensive attention over the past decades with different applications including Light Emitting Diodes (LEDs), photodetectors, transistors, spectrometers, medical imaging, quantum computing and solar cells due to their unique size dependent optoelectronic properties. Quantum dot-sensitized solar cells have gained more attention in the area of solar energy conversion systems due to their low production cost and the excellent properties such as the ability of multiple exciton generation and high molar extinction coefficients. TiO_2 nanofiber-based photoanodes were grown with an optimized quantity and size of PbS quantum dots prepared by Successive Ionic Layer Adsorption and Reaction (SILAR) technique to absorb the photons from the visible to near-infrared region of the solar spectrum. Nanofibers and photoanodes were optically and morphologically characterized. Solar cells were fabricated using PbS quantum dot sensitized normal TiO_2 P25 photoanodes and also PbS quantum dot sensitized TiO_2 nanofiber photoanodes, maintaining equal thicknesses for both types of photoanodes. These solar cells were characterized under the simulated light of 100 mW cm^{-2} with AM 1.5 spectral filter. Overall power conversion efficiency and short-circuit current density of the solar cells are enhanced by around 33% and 26% respectively due to the use of TiO_2 nanofibers. These can be attributed to the enhanced light absorption caused by multiple scattering and effective electron injection caused by the nanofibers and also due to the high amount of quantum dot formation due to the large surface area of the TiO_2 nanofiber photoanode.

Keywords: Molar extinction coefficient, Multiple exciton generation, Multiple light scattering, Quantum dots

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