Ag Decorated TiO_2 Nanoparticles Synthesized by Rapid Photo Deposition Technique as Electron Transport Layer (ETL) for Dye-Sensitized and Perovskite Solar Cells

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Abstract

Electron transport layer is one of the important part in the dye-sensitized and perovskite solar cells which is responsible for the transport of photo-generated electrons to the outer circuit. Thus, selection of appropriate Electron transport layer (ETL) is important for attaining higher power conversion efficiency. Localised surface plasmon resonance can be used as a strategy to improve the total light absorption and it also has been reported that the metallic nanoparticles induce localized electric field, which can excite dye/perovskite molecules more effectively than far-field light which would lead to enhanced light absorption by the adsorbed dye/perovskite molecule which in turn would result in improved generation of photo-excited electrons. In this work TiO_2 nanoparticles were synthesized by a simple solvothermal method and the Ag nanoparticles were decorated over TiO_2 by photo deposition technique. The X-ray diffraction analysis of the sample showed characteristic peaks for anatase phase of TiO_2 and the Ag decorated TiO_2 showed peaks corresponding to (200) planes of Ag nanoparticles. Optical properties were studied using UV-visible absorption analysis and it showed strong absorption in the UV region for TiO_2 and the surface plasma resonance (SPR) effect is observed in Ag decorated samples. TEM analysis showed the presence of near-spherical shape Ag nanoparticles which were present uniformly over TiO_2 nanoparticles. XPS analysis revealed the chemical states of the prepared material. For the constructed DSSC using the prepared material, open circuit voltage (Voc) of 0.67 V and 0.69 V and efficiency (η) of 5.4 and 7.3 % were obtained for bare TiO_2 and Ag decorated TiO_2 based solar cells respectively. A similar trend of enhanced performance was observed for the Ag decorated TiO_2 when compared to bare TiO_2 when used as ETL layer in the case of perovskite solar cells as well.

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