Electrochemical deposition of CdSe-sensitized TiO_2 nanotube arrays with enhanced photoelectrochemical performance for solar cell application

ABSTRACT

Particular interest has been given to the self-organized titania nanotube TiO_2 thin films prepared by using anodisation method followed by annealing in the air, while the CdSe layer was potentiostatically electrodeposited onto the TiO_2 nanotube films at various pH. The resulting films were studied by using energy dispersive X-ray spectroscopy, X-ray diffraction, field emission scanning electron microscopy, UV–Vis spectroscopy and photoelectrochemical analysis to characterize their compositional, crystalline structure, surface morphological, optical, and photoconversion efficiency characteristics. The resulting CdSe/TiO_2 nanotube exhibits significant enhancement in optical absorption, photocurrent density and photoconversion efficiency. CdSe/TiO_2 nanotube prepared at pH 3 exhibited the highest photocurrent density of 2.13 mA cm^{-2} and photoconversion efficiency of 1.02 % which is 51 times higher than TiO_2 nanotube array. This may due to the formation of CdSe nanocrystals which were well crystallized and bonded with TiO_2 NTAs contributing to the enhanced photoresponse and photostability of the overall performance of CdSe/TiO_2 NTAs heterostructures.

Keyword: TiO2; Chemical bath deposition; Photocurrent density; CdSe nanoparticles; Photoconversion efficiency