Oral presentation: 187

Electrodeposited homojunction Cu_2O solar cell on FTO substrate

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Cuprous oxide (Cu_2O), an abundant photoactive semiconducting material has optimum optoelectronic properties to develop efficient, inexpensive and eco-friendly solar cells. Even though, it is possible to fabricate Cu_2O based hetero or Schottky junction solar cells, it is believed that the reduction of interface strains via application of surface treatments can produce best efficient homojunction Cu_2O solar cell. Apart from the homogeneity of a p-n junction, reduction of contact resistances of a solar cell also has a great impact on its overall performance. Previous studies have shown that, annealing and/or sulphidation of thin film Cu_2O enhances the surface properties while sulphided p-Cu_2O/Au junction exhibits ohmic behavior as well. Thus, in this study possibility of developing efficient thin film homojunction Cu_2O solar cell on FTO substrate was tested by improving the surface properties of n- and p-Cu_2O thin film layers. n-Cu_2O thin film was potentiostatically electrodeposited in a three electrode photoelectrochemical cell, contained 0.1 M sodium acetate and 0.01 M cupric acetate, acetic acid at bath pH value of 6.1 and then, this thin film FTO/n-Cu_2O photoelectrode was annealed at temperature of 400^0C to form very thin p-Cu_2O layer with lower surface defects. Subsequently, for a thicker absorber layer a thin film p-type Cu_2O was electrodeposited on annealed FTO/n-Cu_2O photoelectrode using a lactate bath, consisted 3 M lactic acid, 0.4 M copper(II) sulphate and 4 M sodium hydroxide at bath pH value of 13.0. Finally, to form ohmic back contact this bi-layer is directly exposed to ammonium sulphide vapor for 8s and sputtered thin film of Au on it. Photoresponses and modulated light induced current-voltage characterization of this final thin film Cu_2O homojunction is given the highest V_{OC} and J_{SC} values of 154 mV and 3.905 mA/cm^{-2} respectively. This result revealed that application of surface treatments to the thin film n-Cu_2O and the bi-layers ameliorates surface properties, thereby the optoelectronic properties. Parameterization of surface treatments and improvements in the front contact will further improve this homojunction solar cell.

Keywords: Electrodeposition, homojunction, solar cells, thin film cuprous oxide

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