ABSTRACT

A stable solid state photovoltaic cell is presented by sandwiching crystal violet dye between n-Cu_2O prepared on a copper substrate and p-CuSCN transparent thin film prepared on n-Cu_2O considerably improving a previously presented (82) solid state photovoltaic cell made from bare p-CuSCN. After sandwiching crystal violet dye between n-Cu_2O and p-CuSCN a photocurrent enhancement can be observed clearly compared to the solid state photovoltaic cells made with bare n-Cu_2O, n-Cu_2O/p-CuSCN and dye deposited p-CuSCN. This photocurrent enhancement with connection to the dye sensitized junction photoelectrode is due to the efficient charge separation process provided at the space charge layer. The variation of photocurrent quantum efficiency (ϕ%) obtained due to dye sensitization with dye concentration (D_o) of the device is presented. A relationship $\phi = AD_o - BD_o^2$ is found by solving the rate equations related to the dye sensitization. Parameters A and B are obtained relating to the rate constants and various factors which can be influenced to ϕ. Demonstrating various experimental results, kinetics of the photocurrent generation in the solid state photovoltaic cell is discussed.

A photoelectrochemical cell is made by sandwiching a dye between p-CuSCN and n-Cu_2O semiconductor films. A photocurrent enhancement is clearly found for the dye sensitized junction photoelectrode n-Cu_2O/Dye/p-CuSCN in comparison to that of the systems p-CuSCN/Dye, n-Cu_2O/p-CuSCN or n-Cu_2O bare photoelectrochemical cells. Well cleaned copper substrates are boiled 15min in a 10^{-4}M $CuSO_4$ solution to fabricate n-Cu_2O films to prepare Cu/n-Cu_2O photoelectrodes. Cu/n-Cu_2O films are immersed in a p-CuSCN

preparation solution to fabricate transparent p-CuSCN thin films, to prepare Cu/n-Cu_2O/p-CuSCN junction photoelectrode. Thereafter, Cu/n-Cu_2O/p-CuSCN films are immersed in a 10^{-3} M Crystal Violet Dye solution for several minutes to prepare Cu/n-Cu_2O/Dye/p-CuSCN photoelectrodes. XRD data reveal that the formation of n-Cu_2O and p-CuSCN thin films in the Cu/n-Cu_2O/p-CuSCN junction photoelectrode. The reason for the photocurrent enhancement in the Cu/n-Cu_2O/Dye/p-CuSCN is the efficient charge separation provided at n-Cu_2O/p-CuSCN junction for the photogenerated carriers created by the dye sensitization process associated with p-CuSCN transparent thin film and the direct light absorption of the n-Cu_2O film. A dye sensitization process between the dye and the n-Cu_2O films is not observed. 10^{-4} M Fe^{2+}/Fe^{3+} redox couple is used as the electrolyte.