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Effect of temperature on photosensitivity of electrodeposited n-Cu_2O/p-Cu_xS thin film junctions

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The purpose of this study was the construction of a standalone microcontroller based ambient light sensing device to interface an ambient light sensor with a temperature correction and to study the effects of temperature on photosensitivity of electrodeposited Cu_2O based thin film p-n junction diodes. Environmentally friendly, low cost, nontoxic cuprous oxides have highly acceptable electrical and optical properties. It has a direct energy gap of about 2 eV at room temperature and has a good absorption coefficient. Cuprous oxide has a good mobility for the majority carriers and a diffusion length of the minority carriers is several micrometers. In this study, an electrolytic solution of 0.1M sodium acetate and 0.01M cupric acetate was used to fabricate Cu_2O thin films on top of Ti substrates using electrodeposition. Electrodeposition was carried out potentiostatically at a potential of -200 mV with respect to the saturated calomel electrode. A Na_2S solution was used to make the n-Cu_2O/p-Cu_xS junction. In order to increase the photocurrent from the fabricated n-Cu_2O/p-Cu_xS junction, the sulphided Cu_2O sample was exposed to ammonium sulphide gas. Then the photocurrent of the n-Cu_2O/p-Cu_xS thin film junction was measured by a constructed microcontroller based light sensing device simultaneously monitoring the intensity of light with a luminance meter HS1010. An important observation made in this study was that the photocurrent of the electrodeposited Cu_2O/Cu_xS thin film junctions depended greatly on the variation of temperature during exposure to light. Thus the junction photocurrent was studied by exposing the junctions to light while monitoring the variation in the photocurrent with the temperature using a DS18B20 temperature sensor. The resulting data were plotted using MATLAB software and it was found that the photocurrent of the thin film p-n junction displayed a variation that was very much linear at low intensities of light. The measured output currents obtained from the p-n junctions and the output values obtained from the temperature sensor were used to display the intensity of light with the temperature correction using an electronic circuit.

Keywords: Temperature effect, Cuprous oxide, Electrodeposition, Photosensitivity