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Growth of Electrodeposited n-Cu_2O Thin Films with Tunable Band Edge Position

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Cuprous oxide (Cu_2O) is one of the best candidate for low cost photovoltaic applications due to its optoelectronic properties. Cu_2O based solar cell devices have already been reported but the efficiency of the devices are very low compare to the theoretical efficiency limit of 20 %. One of the major drawbacks of the PV devices made with Cu_2O is the unfavorable band edge positions of the semicondcutors in contact. Indeed, the possibility of relative band edge shifts of Cu_2O with suitable interfacing materials will pave the way for interface engineering to improve the efficiency of Cu_2O based devices. In this study we have investigated this possibility of using electrodeposited n-type cuprous oxide thin films deposited using an acetate bath containing 0.1M sodium acetate and 0.01M cupric acetate at various pH values. In order to fabricate Au/n-Cu_2O Schottky junction, thin Au layers having the area of 2X2 mm^2 were sputtered on these Cu_2O films and then these samples were employed with capacitance-voltage measurements to study the flat band potential variations with the pH of the Cu_2O film deposition baths. It was observed that pH value of the Cu_2O film deposition bath is very sensitive to the flat band potential and observed the flat band potential shift of about 450 mV in the negative direction, as the pH of the deposition bath was changed from 6.2 to 5.5. This result gives a direct evidence that the surface of n-Cu_2O film can be modified with the deposition bath pH. The observed shift in the flat band potential is very useful to match the band edge positions of the p-type semicondcutors in contact to fabricate high efficient Cu_2O base PV device. National Research council is gratefully acknowledged for the financial assistance through the research grant NRC 15-41.

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