

Title

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Introduction

Cuprous oxide (Cu_2O) as a naturally p-type semiconductor has a direct band gap of 2.0eV which is suitable for photovoltaic conversion. Recently, Cu_2O has gained great interest due to its potential application to low cost solar cells. A critical issue about Solar Cells is to obtain high stability and low resistance contacts with semiconductors. In this research, we consider Cu-Mn alloy for the first time for metal contact electrode on Cu_2O substrate. We study and determine the optimum experimental conditions to form ohmic contact between Cu-Mn alloy and Cu_2O semiconductor.

Experimental details

Cu_2O film was deposited to 500nm on glass substrate by RF sputtering with O_2 flow rate of 0.855ccm and sputtering power of 50W. As metal electrodes on Cu_2O film, 100nm Cu-4at.%Mn alloy film was deposited by DC sputtering. Subsequently, contacts were defined by photolithograph and select wet-etching for transmission line method (TLM) measurement to evaluate contact properties.

Results and discussions

We tested various solutions in order to achieve high wet-etch selectivity between Cu-Mn and Cu_2O layers and found out the possibility of selective etching from $(\text{NH}_4)_2\text{S}_2\text{O}_8$. The etch rate of Cu-Mn alloy is required in the range of 200~700nm/min for the stable etching time. Meanwhile, the etching selectivity ratio should be as high as possible for uniform pattern structure.

Fig.1 shows the etch rate and the etching selectivity at the various concentration of $(\text{NH}_4)_2\text{S}_2\text{O}_8$ solution. In this plot, 0.05mol/l $(\text{NH}_4)_2\text{S}_2\text{O}_8$ is the ideal etchant for Cu-Mn and Cu_2O with an etching selectivity of 7.31 and etch rate of Cu-Mn is 284.4nm/min.

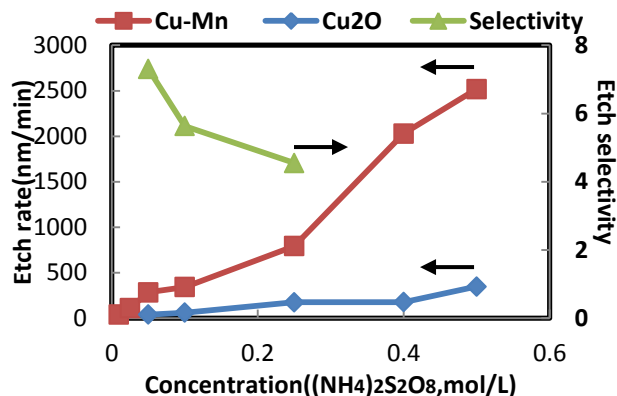


Fig.1 Etch rates and etching selectivity of various concentrations of $(\text{NH}_4)_2\text{S}_2\text{O}_8$ solution.

Fig.2 shows I-V characteristics measured between two TLM pads separated by various distances without annealing. The Cu-4at.%Mn electrodes exhibit linear I-V curves which indicate ohmic contact. The specific contact resistance (ρ_c) is estimated to be $1.35 \times 10^{-2} \Omega \cdot \text{cm}^2$, as derived from resistance versus pad distance plot.

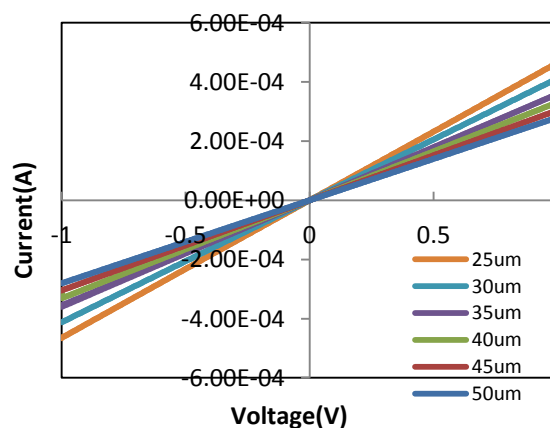


Fig.2 I-V characteristics measured at different distances of 25, 30, 35, 40, 45 and 50 μm .

Conclusions

Ohmic contact [$\rho_c = 1.35 \times 10^{-2} \Omega \cdot \text{cm}^2$] was obtained between Cu-Mn alloy electrode and Cu_2O semiconductor using 0.05M $(\text{NH}_4)_2\text{S}_2\text{O}_8$ as etchant.