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Effect of oxygen partial pressures on structural and electrical properties of dc magnetron sputtered $CuAlO_2$ films

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Wide band gap p-type transparent conducting oxide (TCO) has been recently focused on the research in order to open up a new range of applications for optoelectronic device technology. Upto now, very limited p-type transparent conducting oxides have been produced successfully. In the present work, p-type transparent conducting copper aluminum oxide ($CuAlO_2$) films has been prepared on glass substrates by dc reactive magnetron sputtering technique under various oxygen partial pressures in the range of $1x10^{-4}$ – $3x10^{-3}$ mbar and at a constant substrate temperature of 523 K. The influence of oxygen partial pressure on their physical properties was systematically characterized by X-ray diffractometer, atomic force microscopy and four point probe method. The dependence of cathode potential on the oxygen partial pressure was explained interms of oxidation of the sputtering target.

The X-ray diffraction results revealed that the structural properties of the films were highly influenced by the oxygen partial pressure. The films exhibited secondary phases of Cu_2O and Al_2O_3 along with $CuAlO_2$ phase at lower and higher oxygen partial pressures of $2x10^{-4}$ and $1x10^{-3}$ mbar, respectively. The single phase $CuAlO_2$ was observed at an oxygen partial pressure of $6x10^{-4}$ mbar. The electrical resistivity of the films was decreased with the increase of oxygen partial pressure. The electrical resistivity of 3.1 Ωcm and Hall mobility of 13.1 $cm^2/V{\cdot}sec$ were obtained at an oxygen partial pressure of $6x10^{-4}$ mbar.