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Effect of thermal annealing on the optoelectronic properties of Cu-Fe-O thin films deposited by reactive magnetron co-sputtering

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Abstract:

In this work, the influences of the temperature and the air residual pressure during post-annealing treatment on the structural, optical and electrical properties of copper iron oxide thin films were investigated. The films were co-sputtered from metallic Cu and Fe targets in the presence of argon and oxygen gas mixture. The powers dissipated on the metallic targets were adjusted to fix the Cu/Fe metallic ratio close to 1 in the films. The as-deposited thin films were initially amorphous, and they were annealed under different oxidizing conditions as a function of the temperatures (380, 450 and 550 °C) and of the air residual pressures (secondary vacuum, primary vacuum, and air atmosphere corresponding to the air residual pressures of 10^{-4} , 10^{-1} and 10^5 Pa respectively). Spinel CuFe_2O_4 were clearly detected by X-ray diffraction analysis after air-annealing. With the diminishing of the air residual pressure, the films are reduced. It was shown that the delafossite CuFeO_2 phase growth is possible in a limited range of temperature and pressure and is accompanied by the crystallization of phase mixture in which the nature of secondary phases depends on the air residual pressure. The optical and electrical properties of Cu-Fe-O thin films were then detailed and discussed according to the structural evolution with the treatment conditions.

Keywords: Copper iron oxide, reactive magnetron sputtering, annealing, air residual pressure, optoelectronic properties.

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