# Preparation of CuO Thin Films by Thermally Oxidized Metallic Cu Films for CdS/CuO Heterojunction Diode

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## ABSTRACT

***Copper thin films were deposited on glass substrates using thermal evaporation in vacuum and then thermally oxidized in air at temperatures of 100-500°C. XRD patterns showed the formation of a fine grain $Cu_2O$ phase at 300°C and a CuO phase at 400°C, respectively. Crystallinity and grain size improved with increasing oxidation temperature. The energy gap of the samples evaluated from absorption measurements was 2.10-2.23 eV. Important electrical parameters of the CuO thin films obtained from oxidizing at 500°C were resistivity of $8.53x10^3$ Ω•cm, carrier concentration of $7.60x10^{13}$ $cm^{-3}$, and mobility of 6.22 $cm^2/V•s$. A prototype of a CdS/CuO thin-film heterojunction diode was successfully prepared by thermal evaporation of CdS thin films on CuO thin-film substrate in a vacuum. The obtained device exhibited a good rectifying behavior from I-V characteristics. Junction parameters calculated using I-V data were barrier height of 5.190 eV, ideality factor of 0.520, and series resistance of 3.87 Ω. Impedance spectroscopy of the device was investigated at temperatures of 25-60°C. The real and imaginary parts of the complex impedance changed with the temperature and frequency. The experimental results suggested that the device was a good candidate for photovoltaic devices with low thermal budget and low product cost.***

**Keywords:** CuO thin films, Thermal oxidation, CdS/CuO heterojunction, Impedance spectroscopy

## INTRODUCTION

Copper oxides are semiconducting materials that have a natural abundance of starting material Cu. They have been extensively studied because of their potential applications in solar cells, gas sensors, electrochemical sensors, and batteries (Valladares, 2012; Ooi et al., 2013). Copper oxides are composed of two oxide phases, namely, cupric oxide (CuO) and cuprous oxide ($Cu_2O$) with p-type conductivity; the former has a narrow band gap of 1.21-1.51 eV absorbing throughout the visible spectrum with a monoclinic structure, while the latter has a direct optical band gap of 2.10-2.60 eV with a cubic structure (Cho et al., 2013). A meta-stable copper oxide, $Cu_4O_3$, which is an intermediate compound between