

Electrochemical Growth and Properties of Cu₂O Nanostructures

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Abstract : Cuprous oxide (Cu₂O) is a well-known oxide semiconductor with a band gap of 2.1 eV and a natural p-type conductivity, which is an attractive material for device applications because of its abundant availability, non toxicity, and low production cost. It has a higher absorption coefficient in the visible region and the minority carrier diffusion length is also suitable for use as a solar cell absorber layer and it has been explored in junction with n type ZnO for photovoltaic applications. Cu₂O nanostructures have been made by a variety of techniques; the electrodeposition method has emerged as one of the most promising processing routes as it is particularly provides advantages such as a low-cost, low temperature and a high level of purity in the products. In this work, Cu₂O nanostructures prepared by electrodeposition from aqueous cupric sulfate solution with citric acid at 65°C onto a fluorine doped tin oxide (FTO) coated glass substrates were investigated. The effects of deposition potential on the electrochemical, surface morphology, structural and optical properties of Cu₂O thin films were investigated. During cyclic voltammetry experiences, the potential interval where the electrodeposition of Cu₂O is carried out was established. The Mott-Schottky (M-S) plot demonstrates that all the films are p-type semiconductors, the flat-band potential and the acceptor density for the Cu₂O thin films are determined. AFM images reveal that the applied potential has a very significant influence on the surface morphology and size of the crystallites of thin Cu₂O. The XRD measurements indicated that all the obtained films display a Cu₂O cubic structure with a strong preferential orientation of the (111) direction. The optical transmission spectra in the UV-Visible domains revealed the highest transmission (75 %), and their calculated gap values increased from 1.93 to 2.24 eV, with increasing potentials.

Keywords : Cu₂O, electrodeposition, Mott-Schottky plot, nanostructure, optical properties, XRD

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