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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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