505/E1

Wettability determined by angle of contact measurements for electrodeposited Cu_2O thin films with sulphur based surface treatments or chlorine doping

J.T. Kalani,[1] H.W.H.S. Weerasinghe,[1]K.N.D. Bandara,[2] J.L.K. Jayasingha,[1] K.M.D.C. Jayathilaka,[3] and J.K.D.S. Jayanetti, [1*]

[1] *Department of Physics, University of Colombo, Colombo 03, Sri Lanka*
[2] *Department of Physics, Open University, Sri Lanka*
[3] *Department of Physics, University of Kelaniya, Kelaniya, Sri Lanka*

The angle of contact (α) was measured for Cu_2O thin films electrodeposited on Ti substrates with either chlorine doping, or with its surface modified using sulphidation followed by surface passivation. The fabrication of *n*-Cu_2O films were done in an acetate bath containing aqueous solutions of 0.1 M sodium acetate and 0.01 M cupric acetate at 60°C. Sulphidation of *n*-Cu_2O films was achieved by applying a thin layer of an aqueous solution of 0.01 M Na_2S on the surface of the film and allowing to react with the film at 200°C. Subsequently, exposure of the sulphided film surface to $(NH_4)_2S$ passivated the film surface. Chlorine doping was done on *p*-Cu_2O films fabricated using electrodeposition. The amount of chlorine doping was varied in *p*-Cu_2O films deposited in a lactate bath containing an aqueous solution of lactic acid (3 M), cupric sulphate (0.45 M) and sodium hydroxide by varying $CuCl_2$ concentrations. Using a custom built experimental setup supplemented by image processing software, α measurements of distilled water on the deposited thin films were made using the sessile drop method. Film morphology was revealed by scanning electron micrographs (SEM), while x-ray diffraction (XRD) spectroscopy was used to probe the structural properties of the films. For distilled water, bare Cu_2O films independent of its conductivity type was found to be non-wetting ($\alpha \geq 90^o$), exhibiting non-polar surface properties of the film. Sulphidation using Na_2S made the surface of the *n*-Cu_2O films highly wetting ($\alpha < 30^o$) as result of the polar nature and the decreased roughness of the sulphided film surface. With subsequent passivation of these sulphided films, the resulting less polar film surface with re-emerged roughness made the films partially wetting ($90^o > \alpha \geq 30^o$). With increased chlorine doping it was found that α measurements increased making the film surfaces more non-wetting for distilled water. It was also noted that when the morphological structures of the films were in the nano-scale the surfaces were more non-wetting in nature. These observations show that surface modifications and doping not only influence the charge transport properties of Cu_2O thin films, but also affects the wettability which is an important consideration in the context of utilizing them as sensors for detecting molecules having varying charge polarization ability.

sumedhajayanetti@gmail.com 0112584777