Cupric Oxide Thin Films Grown by DC Magnetron Sputtering for Photovoltaic Applications

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Abstract

Solar energy has been considered as one of the cleanest forms of energy. Though conventional silicon solar cells are leading the market, recently, there are many alternative materials found attractive in the solar photovoltaic research in order to replace the silicon. Among them, metal oxides are also in the competition to prove themselves as solar materials. Copper oxide (Cu_xO) system is selected as an absorber in the present study because of its abundance and its high absorption coefficient. Thin films of Cu_xO were grown by dc magnetron reactive sputtering by using copper targets of high purity (99.99%). Argon and oxygen gases serve as the sputter and reactive gases, respectively. The films were prepared by varying the deposition parameters such as $Ar:O_2$ ratio and sputter power. The phase transformation in the Cu_xO thin films was analysed by varying the $Ar:O_2$ ratio during deposition through x-ray diffraction and x-ray photoelectron spectroscopy analysis. It was found that the films deposited at lower $Ar:O_2$ ratio crystallizes in Cu_2O phase (for e.g. 8:1) and CuO phase predominated in the films deposited at higher $Ar:O_2$ ratio such as 8:6. We have observed that there is an optimum sputter power range (50-80W) in which a CuO phase with low band gap value and comparatively high absorption coefficient values could be achieved which is desired for photovoltaic applications. The electrical resistivity has shown a decreasing trend with increase in sputter power during deposition. At high sputter powers of 80W, the electrical resistivity showed a low value due to the better crystallinity of the films. The structural, optical and electrical properties of the studied films suggested that these films could be used as absorber layer for oxide based solar cells.