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Structural and Optical Properties of RF-Sputtered ZnS and Zn(S,O) Thin Films

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Abstract : Zinc sulfide [ZnS] and oxygenated zinc sulfide Zn(O,S) thin films were deposited on glass substrates, by reactive cathodic radio-frequency (RF) sputtering. The substrates power and percentage of oxygen were varied in the range of 100W to 250W and from 5% to 20% respectively. The structural, morphological and optical properties of these thin films were investigated. The optical properties (mainly the refractive index, absorption coefficient and optical band gap) were examined by optical transmission measurements in the ultraviolet-visible-near Infrared wavelength range. XRD analysis indicated that all sputtered ZnS films were a single phase with a preferential orientation along the (111) plane of zinc blend (ZB). The crystallite size was in the range of 19.5 nm to 48.5 nm, the crystallite size varied with RF power reaching a maximum at 200 W. The Zn(O,S) films, on the other hand, were amorphous. UV-Visible, measurements showed that the ZnS film had more than 80% transmittance in the visible wavelength region while that of Zn(O,S is 85%. Moreover, it was observed that the band gap energy of the ZnS films increases slightly from 3.4 to 3.52 eV as the RF power was increased. The optical band gap of Zn(O,S), on the other hand, decreased from 4.2 to 3.89 eV as the oxygen partial pressure is increased in the sputtering atmosphere at a fixed RF-power. Scanning electron microscopy observations revealed smooth surfaces for both type of films. The X-ray reflectometry measurements on the ZnS films showed that the density of the films (3.9 g/cm3) is close that of bulk ZnS.

Keywords : thin films Zn(O,S) properties, Zn(O,S) by Rf-sputtering, ZnS for solar cells, thin films for renewable energy
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