Effect of deposition time on structural and optical properties ofZnS thin films elaborated by spray ultrasonic method

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Abstract

The Zinc Sulfide (ZnS) semiconductor shows remarkable fundamental properties versatility and a promise for novel diverse applications, including light-emitting diodes (LEDs), electroluminescence, flat panel displays, infrared windows, sensors, lasers, and biodevices. Its atomic structure and chemical properties are comparable to more popular and widely known ZnO semiconductor.

However, certain properties of ZnS are unique and advantageous compared to ZnO. For example, ZnS has a larger band gap of 3.72 eV and 3.77 eV (for cubic zinc blende (ZB) and hexagonal wurtzite (WZ) structures, respectively) than ZnO (3.4 eV) and this characteristic make it more suitable for the fabrication of devices using short wavelengths

Although ZnS is traditionally the most suitable candidate for electroluminescence devices, the nanostructures of ZnS are not yet investigated in details relative to ZnO nanostructures.

This work is conducting in the way to prepare and analyze thin films of ZnS coated on glass substrate, heated to temperature of 480°C, by ultrasonic spray chemical technique (SPC). The used solution is a mixture 0.1M of Zinc acetate as source of Zn, 0.1M of Thiourea as source of S and methanol as a solvent. Several factors influence the formation of ZnS and particularly the deposition time which is in the range of 2-7 minutes. Structural, morphological, chemical composition and Optical properties of the obtained thin films were studied using XRD, scanning electron microscopy, optical transmittance spectroscopy.

For the short time of deposition, the results of X-ray diffraction reveal amorphous structure of ZnS but with rising deposition time the crystallinity was improved and the films exhibit a peak at $2\theta=28,8°$ corresponding to the wurtzite phase of ZnS. This result was confirmed by the Scanning electron microscopy (SEM). At deposition time of 7 minutes, a small peak of ZnO appears and the intensity of ZnS phase decrease. The nanometric size of ZnS crystallites was estimated by the formula of Debye-Scherrer. The optical transmission increase from 57% to 83% and optical gap varied slightly with deposition time.

Keywords: ZnS thin films; ultrasonic spray; deposition time; XRD; optical properties.