POST-DEPOSITION THERMAL TREATMENT OF SPRAYED SnS FILMS

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SnS is a promising absorber material for solar cells due to its high absorption coefficient [1], non-toxicity and availability of tin and sulfur. Chemical spray pyrolysis is a simple, fast and cost-effective method to deposit thin film. Acidic aqueous solutions containing tin chloride ($SnCl_2$) and thiourea ($SC(NH_2)_2$) at molar ratios of 1:1 and 1:8 were pulverized onto glass substrates at 200 °C in air to obtain SnS films. In this study we investigated the influence of post-deposition annealing in nitrogen and vacuum at 450 °C for 60 min on properties of sprayed SnS films. Films were characterized by X-ray diffraction (XRD), Raman and UV-Vis spectroscopies, scanning electron microscopy (SEM) and energy dispersive X-ray analysis (EDX).

As-deposited films are composed of cubic SnS as the main crystalline phase independent of precursors' molar ratio in the spray solution, the mean crystallite size is 35 and 17 nm for 1:8 and 1:1 films, respectively. Thermal treatment of 1:8 films in nitrogen results in Sn_2S_3 as the main phase, SnS is present as the minor phase. Annealing of 1:8 films in vacuum results in orthorhombic SnS phase, films show optical band gap of 1.4 eV. Thermal annealing of 1:1 films in vacuum leads to metallic Sn, whilst annealing in nitrogen results in films composed of a mixture of SnS and SnO_2 phases. Formation of SnO_2 in an inert atmosphere indicates presence of oxygen containing phases already in the as-grown film.

Chemical reactions taking place during thermal treatments as well as optimal deposition and post-deposition treatment conditions for fabrication of SnS single phase films will be discussed.

References

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