THE EFFECT OF TARTARIC ACID IN THE DEPOSITION OF Sb_2S_3 FILMS BY CHEMICAL SPRAY PYROLYSIS

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Chemical bath deposited Sb_2S_3 film has been used as absorber in extremely thin absorber solar cells [1]. Here, Sb_2S_3 films were chemically sprayed by atomising aqueous spray solution, consisting of $SbCl_3$ (Sb=2 mmol/L), thiourea (S) and tartaric acid (TA) in molar ratios of Sb:S:TA=1:3:10 (as utilised in [2,3]) or 1:3:1, onto preheated glass substrates. The growth temperature (T) varied 205°C-230°C and 205°C-355°C for Sb:S:TA=1:3:10 and 1:3:1, respectively. Effects of TA concentration in spray solution, growth temperature and annealing temperature on the film properties were studied with X-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX) and Fourier transform infrared spectroscopy (FTIR). Additionally, thermogravimetric and differential thermal analysis (TG/DTA) of TA was carried out.

Sb_2S_3 film grown at 205°C from solution with Sb:S:TA=1:3:10 is ca. 1 μm thick, contains ortho-rhombic stibnite (Sb_2S_3) phase and high amount of carbon and oxygen residues. Reduced TAs concentration of 1:3:1 in spray solution leads to orthorhombic Sb_2S_3 film with decreased carbon and oxygen content in the film compared to solutions with Sb:S:TA=1:3:10. Increasing T from 205°C to 355°C decreases the mean crystallite size from 25 nm to 15 nm while a decrease in sulphur and an increase in oxygen content are detected. According to SEM, the morphology and the thickness of Sb_2S_3 film grown from Sb:S:TA=1:3:1 are heterogeneous and film thickness decreases with increasing T. FTIR spectra of Sb_2S_3 film substance confirm that the used T is insufficient for the TA to decompose. According to the TG/DTA, TA decomposition takes place in three steps where 95% of mass is lost by 254°C and TA is totally decomposed at 495°C. Innovatively, Sb_2S_3 films with Eg=1.7 eV were sprayed from alcohol solvents.

References

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