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Post-deposition thermal treatment of sprayed SnS films

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Abstract

SnS films were grown by the chemical spray pyrolysis method using aqueous solutions containing $SnCl_2$ and $SC(NH_2)_2$ at molar ratios of 1:1 and 1:8 in air at a substrate temperature of 200 °C. As-deposited films were thermally treated at 450 °C in nitrogen and vacuum atmospheres. All samples were studied using X-ray diffractometry, Raman spectroscopy, energy-dispersive X-ray analysis, and ultraviolet–visible spectroscopy. The as-grown films consisted of cubic SnS as the only crystalline phase regardless of the molar ratio of the precursors in the spray solution. Annealing of the 1:1 films (derived from the 1:1 solution) in vacuum yielded metallic Sn, whereas annealing in N_2 produced films composed of a mixture of cubic SnS and SnO_2 phases, indicating the presence of oxygen-containing non-crystalline phases in the as-grown films. Thermal treatment of the 1:8 films in nitrogen yielded films composed of Sn_2S_3, whereas vacuum annealing produced films consisting of orthorhombic SnS with a bandgap energy of 1.4 eV.