Thermally induced phase transition in Sn_xS_y thin films

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Presently, the earth-abundant and non-toxic SnS_2 and SnS compounds could be considered as the promising optoelectronic material. This is due the fact that SnS_2 has n-type conductivity, high carrier mobility and wide band gap of 2.2 eV. These properties make it possible to use SnS_2 as a window layer in solar cells. Whereas SnS has p-type conductivity, high absorption coefficient and band gap of about 1.3 eV is suitable material for absorber layer in thin film solar cells. Also opposite conductivity of SnS and SnS_2 gives an opportunity to create n - SnS_2/p - SnS heterojunction.

SnS_2 films were obtained by the close-spaced vacuum sublimation method. SEM images of the surface and cross-section of the obtained samples shows that films consist of plate-like crystallites with average grain size of 2 μm. Thickness of the films was 4 μm. The annealing of the samples was carried out at 300, 400 and 500 ^{0}C for 30, 60 and 90 min for each of temperatures in vacuum. In order to study phase composition of the Sn_xS_y films XRD and Raman spectroscopy were used. It was determined that annealing in vacuum of SnS_2 films at 500 ^{0}C for 90 min leads to the formation of single phase SnS. While, the smaller time and temperature of annealing leads to the mixed phase composition of SnS, Sn_2S_3 and SnS_2. Annealing at 500 C for 90 min lead to the porous structure of the material. EDS analysis shows that the non-annealed films has typical for SnS_2 value of Sn:S ratio of 0.49 . Annealing at higher temperature of 500 ^{0}C for 90 min shows that films have Sn:S ratio of 0.96. That is close to stoichiometric composition of SnS compound. These results confirm the XRD and Raman data indicating that annealing at 500 ^{0}C for 90 min lead to phase transition from hexagonal SnS_2 to orthorhombic SnS.

Бібліографічний опис

Thermally induced phase transition in Sn_xS_y thin films [Text] / A.A. Vozny, V.V. Kosyak // Materials of European Materials Research (E-MRS) Society Spring Meeting, Lille, 2-6 May. - Lille, 2016. - P. 2.27.