# Post-growth treatment of $Sn_xS_y$ thin films

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In this study, the effect of post-growth thermal annealing and laser irradiation on phase composition, structural, optical and electrical properties of $SnS_2$ obtained by the close-spaced sublimation on ITO substrates was studied. It was found, by using EDS, XRD and Raman methods that as-grown samples have single phase $SnS_2$ structure and their chemical composition is close to stoichiometric. In order to determine annealing conditions for phase transition from $SnS_2$ to SnS the samples were annealed in vacuum under different temperature and time. It was determined that annealing in the vacuum of $SnS_2$ films at 500 $^0$C for 90 min leads to the formation of single phase stoichiometric SnS. The laser annealing of the $SnS_2$ thin films sample was performed by the Nd:YAG laser, with two intensities of radiation of 8.5 and 11.5 MW/cm$^2$. It was established, that irradiation of the samples with 8.5 MW/cm$^2$ intensity leads to the coalescence of grains accompanied with smoothing of the surface. The EDS line scan of the samples cross section shows that chemical composition of the layer at the irradiated surface is close to SnS, while near the substrate the chemical composition remains the same as before irradiation. Formation of SnS phase was also confirmed by the XRD and Raman methods. The application of 11.5 MW/cm$^2$ laser radiation leads to the formation of SnS phase not only at the surface but in the whole volume of samples. The I-V characteristics of the ITO/$Sn_xS_y$/Al samples show ohmic behaviour in a case of non-irradiated and irradiated with high 11.5 MW/cm$^2$ intensity samples. While for the samples irradiated with 8.5 MW/cm$^2$ intensity the diode behaviour of I-V curve was observed. It could be considered as an evidence of formation of p-SnS/n-$SnS_2$ hetorojunction structure.

**Бібліографічний опис:**

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