The Diagnostics of Nanosized Tin Disulfide Films by Modulation Polarimetry Technique of Surface Plasmon Resonance

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The tin-sulfur system can form a variety of crystalline phases such as SnS, Sn_2S_3, SnS_2 with a different band gaps. A number of these compounds can be obtained by both p- and n-type conductivity. This allows to create a solar cells (SC) with a heterojunction based on different phases of the same compound (eg, n-SnS2/p-SnS), which significantly simplifies their production and reduces cost [1]. The increasing of SE efficiency needs the optimization of the structural characteristics of the surface layers SnS_2 as a syllabic element. The application of modulation polarimetry technique of surface plasmon resonance allows to characterize the structure of nanosized films by studying of their polarization features [2]. The samples of SnS_2 films were obtained by thermal evaporation method of compound in a quasi-closed volume in the installation VUP-5M (P = $5 \cdot 10^{-3}$ Pa) at a different substrate temperature T_s=175-275°C. The mass thickness of samples was d=50nm. It is shown, that there are two mechanism of resonance interaction of radiation with the electron subsystem of samples which expressed in the angular and spectral characteristics of the polarization difference $\rho(\lambda,\theta)=R_s^2-R_p^2$ (R_s^2 and R_p^2 are the internal reflection coefficients of s- and p-polarized radiation, respectively) in the λ=400-1000nm wavelength range. The resonance excitation of the localized surface plasmons (LSP) and the surface plasmon polaritons (SPP) were found by light. As a results of spectrums analysis $\rho(\lambda)$ the dispersion characteristics $\omega(k)$ consisted of three frequency branches were obtained. One of them is low-frequency branch corresponds to the excitation of SPP (non-radiative region), two others are high-frequency branch corresponds to the excitation of LSP on nanoparticles (radiative region) and on roughness (non-radiative region). The ratio between the amplitudes of LPP and SPP resonances is determined by the structural features of SnS_2 films due to various T_s. The practical application of experimental data conclude in the fact that the increasing of the substrate temperature leads to formation of a more homogeneous lower layer of film with increasing of surface roughness with a further formation of aggregates on the surface of SnS_2 films. Our studies show the perspective of modulation polarimetry technique for diagnostics of structural homogeneity of nanocomposite films.

1. A. Sanchez-Juareza, A. Tiburcio-Silverb, A. Ortiz, *Thin Solid Films* 480, (2005), 452.
2. B. K. Serdega, S. P. Rudenko, L. S. Maksimenko, I. E. Matyash. Polarimetric Detection, Characterization and Remote Sensing / NATO Science for Peace and Security Series C. Springer Science + Business Media. B.V, (2011), 473.