Optical and electrical characteristics of FeS2 thin films obtained in gas discharge

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Iron disulfide FeS_2 (pyrite) is a non-toxic material, and due to its wide distribution on Earth, it has the prospect of becoming a low-cost alternative for creating high-efficiency solar cells. This is facilitated both by its environmental friendliness and optical properties close to optimal for efficient conversion of radiation energy: the bandgap energy is 0.95 eV, and the optical absorption coefficient is more significant than 10^5 cm^{-1} at energy hv> 1.4 eV. Iron and sulfur can form sulfides with different stoichiometric compositions and structures during film fabrication, which affects the material properties. Considering the complex zone structure , FeS_2 thin films with a wide range of intrinsic absorption (from 1 to 3.8 eV) are obtained. Depending on their optical properties, they can be used in solar cells as a photoactive absorbing layer or as a frontal translucent layer in heterostructures.

This paper presents the results of the study of electrical and optical properties of FeS_2 thin films obtained by sputtering in gas discharge plasma at temperatures from 250 to 350◦C. To study electrical and optical properties, film samples were used on quartz glass substrates of 11 × 11 mm.

Fig 1. FeS2 thin film samples on quartz glass substrates of 11 × 11 mm.

Transmission spectra of thin films were recorded using a spectrometer based on an MS 7504i spectral monochromator. A hydrogen source was used as an emission source.

The block diagram of the automated measuring system for studying the optical characteristics of ferroelectrics is shown in Figure 2 and dependence of FeS2 film transmittance coefficient under hydrogen lamp illumination is shown in Figure 3

Fig2. The block diagram for studying the optical characteristics

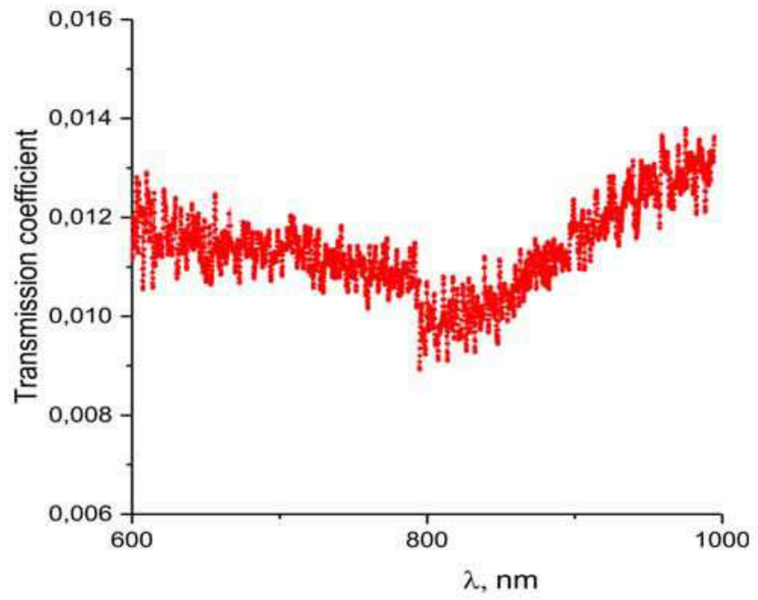

Fig3. FeS2 film transmittance coefficient

The block diagram of the automated measuring system for studying the temperature dependence of dielectric spectra of ferroelectrics is shown in Figure 4 and temperature dependency of conductivity of the FeS_2 thin films is shown in Figure 5

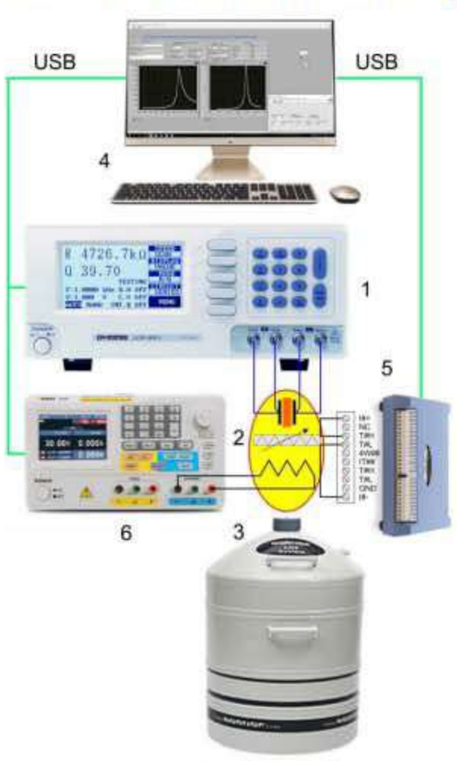

Fig4. The block diagram for studying the temperature dependence

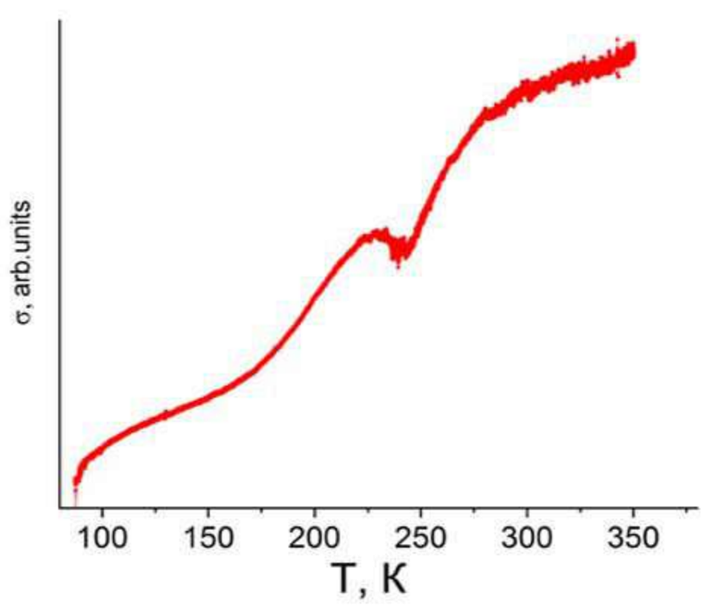

Fig5. The temperature dependency of conductivity of the FeS_2