INFLUENCE OF DEPOSITION CONDITIONS ON THE PROPERTIES OF Sb_2S_3 LAYERS ON FTO SUBSTRATES

Evelina Kasparavičiūtė[1], Remigijus Ivanauskas[1], Skirma Žalenkienė[1]

[1] Kaunas University of Technology, Kaunas, Lithuania
evelina.kasparaviciute@ktu.edu

The rapidly developing solar energy industry offers an excellent alternative to fossil fuels, the use of which contributes to climate change. Therefore, the search for efficient, resource-saving, and environmentally friendly materials suitable for use in solar energy technologies is ongoing. Antimony halide layers are an excellent alternative to toxic lead, cadmium, or mercury compounds in solar cells. Antimony sulfide (Sb_2S_3) is a p-type semiconductor with a direct optical band gap in the range of 1.6–2.46 eV [1] and a high absorption coefficient ($^{>}10^5$ cm^{-1}) in the visible spectrum (400–700 nm) [2], making it a very efficient light absorber in photovoltaic cells and photodetectors. Furthermore, its layers 1 µm thick can absorb 95% of incident solar radiation. In addition, Antimony is widely distributed on Earth, and Sb_2S_3 is chemically stable, non-toxic, resistant to temperature fluctuations, and durable.

The morphology, crystal structure, defect concentration, thickness, adhesion to the substrate surface and, as a consequence, optical and electrical properties of the formed layer depend on the method of formation of Sb_2S_3 layers. In this work, Sb_2S_3 layers were formed on the surface of fluorinated tin oxide (FTO) slides by three methods: chemical bath deposition (CBD), sequential ion absorption and reaction (SILAR), and drop casting (DC). In addition, after depositing Sb_2S_3 films on the surface of FTO substrates, they were washed, dried, and annealed for 1 h in a nitrogen atmosphere at 250 °C. The conducted studies showed that the band gap values of Sb_2S_3 layers deposited by all methods are similar and vary from 1.66 eV to 1.8 eV, but the best adhesion to the FTO substrate surface and coating homogeneity were observed in layers formed by chemical bath deposition method.

[1] M. Wu et al., “Correlative and In Situ Microscopy Investigation of Phase Transformation, Crystal Growth, and Degradation of Antimony Sulfide Thin Films,” vol. 19, no. 27, pp. 25017–25027, July 2025, doi: 10.1021/acsnano.5c04342
[2] H. Min, “A Review On Antimony Trisulfide Thin Films,” vol. 32, pp. 597–601, 2020.