Tailoring the Structural, Optical, and Optoelectrical Properties of Innovative N-Type Ag2znsns4 Thin Films and Investigating ITO/Ag2znsns4/Sns/Au Heterojunction

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Abstract:

This work aims to create silver zinc tin sulfide (Ag2ZnSnS4) layers with various thicknesses (254, 381, 473, and 539 nm) by a simple chemical deposition technique. The X-ray diffraction data revealed that the as-prepared Ag2ZnSnS4 films are polycrystalline, and all films have a single Ag2ZnSnS4 phase with a tetragonal structure. The morphology of the Ag2ZnSnS4 films was investigated by FE-SEM, which refers to the surface homogeneity of the investigated Ag2ZnSnS4 films. Measurements of transmittance and reflectance of the Ag2ZnSnS4 films studied the optical properties of the chemically prepared Ag2ZnSnS4 films. The analysis of the refractive indices of the investigated films reveals an increase in these values occurred by enlarging the deposition time and film thickness. The energy gap calculations displayed a direct optical transition in thin films of Ag2ZnSnS4 that decreased from 3.53 to 3.06 eV with the growth in the thickness. Furthermore, the optoelectrical indices and nonlinear optical parameters of the Ag2ZnSnS4 films, such as electrical conductivity, optical mobility, and optical conductivity, were enhanced by increasing the thickness. The hot-probe experiment refers to the Ag2ZnSnS4 samples are n-type semiconductors. Ultimately, Ag2ZnSnS4 films are promising n-type semiconductors that might be used in various photovoltaic and optoelectronic applications, particularly the economic window layer for solar cells. Conversely, ITO/Ag2ZnSnS4/SnS/Au heterojunction was created. The solar conversion efficiency of this heterojunction device is 7.27%. The outcomes dem- onstrated that these Ag2ZnSnS4 samples can be used to thin-film solar cells as a novel window layer.