Turkish Journal of Physics

Turkish Journal

of

Physics

The influence of Ge content and annealing temperature on the d.c and a.c conductivity of Ge_xSe_{1-x} thin films

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Abstract: Various samples of Ge_xSe_{1-x} system have been prepared for x = 0.05, 0.15& 0.25 in an evacuated quartz tube. Thin films of Ge_xSe_{1-x} film have been prepared via a thermal evaporation method with 350 \pm 5 nm thickness and rate deposition 6 nm/s. The alloy structure and thin films have been examined by X-ray diffraction (XRD). Atomic absorption spectroscopy (AAS) was used to examine the concentration of the composite elements (Ge and Se). The d.c and a.c conductivity of Ge_xSe_{1-x} thin film have been studied as a function of Ge content x and annealing temperature within the range 303--448 K. Our results showed that the dc conductivity σ of thin Ge_xSe_{1-x} films increases with increasing Ge content and decreases with increasing annealing temperature T_a. Electrical activation energy E_a decreases with increasing x values and increases with increasing annealing temperature. The a.c conductivity increases with increasing x values. The exponent s in the relation $\sigma_{a.c}$ \propto ω^s, and which determines the transfer mechanism, decreases with increasing x and T_a. While the electrical a.c activation energy E_ω increases with increasing x and T_a and at frequencies f = 10^2, 10^3 and 10^5 Hz. The relaxation time τ and polarizibility α have been measured from the cole-cole plot for x = 0.05 at T_a = 303, 398 and 448 K, with the finding that the relaxation time and polarizibility decreased with increasing T_a.

Key Words: a.c conductivity, d.c conductivity, thin Ge_xSe_{1-x} film, dielectric constant

Turk. J. Phys., **27**, (2003), 133-144.
Full text: pdf
Other articles published in the same issue: Turk. J. Phys.,vol.27,iss.2.