Carrier Scattering in Thin Films Tin Telluride

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Tin Telluride is a promising thermoelectric material with stable p-type conductivity for medium range (500-750) K. Thin-film material substantially extends beyond its practical use. The properties of polycrystalline thin films largely depend on electronic processes that occur at interfaces within. Here, in particular, be aware scattering at interfaces and within Intergrain, misfit dislocations and other defects of growth. The localization of current carriers, surface conditions and their capture of dangling bonds at the boundaries of crystallites leading to the formation near the regions of space charge concentration and mobility of charge carriers in can differ from that of the in volume.

From the AFM image of the surface nanostructures can be seen that the vapor-phase condensation of nanosized crystallites formed pyramidal shape. Established that the average size of the nanocrystals condensate thickness increases. Doping Bi condensates SnTe results in reducing the size of nanocrystals.

As for the thickness dependence of the electrical parameters of the vapor-phase condensation, they are as follows. Specific conductivity (σ) of the thickness (d) (1 decrease / d) increases for all of these structures. Thus with increasing Bi content dopant throughout the range of thicknesses condensate σ value decreases.

Current carrier mobility (μ) condensates SnTe: Bi adequately replaced with a thickness (d): slightly increases with d. The latter correlates well as the nature of resizing nanocrystals: increase the size of their saturation characteristic values for condensates with d> 500 nm. It should also be noted the fact that the charge carriers mobility (μ) doped structures in two galleries times higher than for pure Tin Telluride.

Note the two important experimental findings: the impact of dopant (Bi) and the thickness of the condensate (d) their complex structure and electrical properties. With respect to the thickness d-dependency, they can explain the mechanisms of carrier scattering in Intergrain and within interphase [5]. In particular, if the prevalence of carrier scattering on the surface (μP) and grain boundaries (μz) charge carriers mobility in the films is determined Mattisen rule [5].

The influence of the thickness pure and bismuth doped tin telluride films deposited on fresh mica substrates (0001) for their nanostructure and scattering mechanisms of charge carrier are researched. Established that the dominant scattering mechanism is surface scattering and scattering on the intergrain boundaries which determined by the dopant content. Crystal chemistry doping mechanisms which associated with placement of Bi atoms in cationic structures are proposed.