The Surface Influence to the Thermoelectric Properties of Vapor-Phase Condensates LAST Pb-Ag-Sb-Te

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The thermoelectric properties and features of carrier scattering in the thin films $Pb_{18}Ag_{2-x}Sb_xTe_{20}$ are researched, which were obtained by the condensation of vapor in the high vacuum on the ceramics and mica substrates. Based on a two-layer Petrits model the electrical parameters of surface layers are found. It is shown that the condensates of thickness near $d < 1$ micron are characterized by the improved thermoelectric properties. The obtained results are interpreted by the adsorption of oxygen on the surface and its diffusion into the interior of condensate. It is established that the dominant role plays carrier scattering on the surface, but not on intergrain boundaries of the nanocrystals, whose sizes increase with the thickness of the vapor-phase structures.

Films for the investigation are received by the deposition of the vapor on pre-synthesized material in vacuum for the fresh chips (0001) of muscovite mica, and sital. The measurement of the thermoelectric parameters of condensates was realized at the room temperature in the constant magnetic and electric fields on the developed automated installation. This installation provides as a process for measuring the electrical parameters, as initial registration and as initial data processing.

The experimental results are explained within the framework of a two-layer Petrits model. Thin film in this model is composed of two layers: a surface layer and a bulk layer, which are connected in to parallel. The designated thermoelectric parameters of the surface layer are significantly different from the bulk layer by the electrical conductivity, the Hall concentration and the Seebeck coefficient.

The thickness d-dependences of mobility are obtained experimentally. They are explained by the mechanisms of carrier scattering on the surface and on the intergrain boundaries of condensates.

On the basis of the research results could be argued that the main contribution into the mobility of the charge carriers are made by the diffuse scattering on the surface (μ_p). The impact of the intergrain boundaries is significantly lower due to increase the grain size.

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1. R.L. Petritz. Theory of an Experiment for Measuring the Mobility and Density of Carriers in the Space-Charge Region of a Semiconductor Surface // Phis. Rev. (110), P. 1254 (1958)..