

The Process of Formation and Thermoelectric Properties of Vapor-Phase Condensates PbTe:Bi, PbTe–Bi₂Te₃

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The progress of modern science and technology are inextricably linked to the improvement of technology of traditional and new semiconductor materials. In particular, special attention to itself attracts Lead telluride. He is an efficient thermoelectric materials for middle temperatures (500-750 K) of high enough quality factor $ZT = 1$ [1]. Because of the small prohibited band gap ($E_g = 0,32$ eV at 300 K) PbTe widely used in devices infrared spectrum [1]. Alloying individual elements, including amphoteric impurity Bi, can greatly modify the basic properties of lead telluride, which is important for practical applications.

Vapor-phase condensates PbTe–Bi₂Te₃ and PbTe:Bi obtained by the method of open evaporation in a vacuum on a substrate of pyroceram. The value of Bi₂Te₃ varied in the range (1-5) mol.%, and a value of Bi – 1mol.%. For PbTe–Bi₂Te₃ the temperature evaporation $T_V = 970$ K and deposition $T_S = 470$ K. Variable parameter was deposition time ($\tau = 15 - 75$ s). Condensates PbTe:Bi grown on various technological factors: temperature sample evaporation $T_V = (920-1020)$ K, deposition temperature (substrate) $T_S = (420 - 520)$ K, deposition time $\tau = (3-120)$ s. We researched the obtained samples with atomic force microscope (AFM) Nanoscope 3a Dimention 3000 (DigitalInstruments USA) in the periodic contact mode.

Also determined depending on the structural characteristics (medium-sized nanocrystals, their rate of change in the lateral (D_c , D_c / τ) and normal (h_c , h_c / τ) directions to the substrate surface) and thermoelectric parameters (electrical conductivity (σ), Hall concentration (n) and mobility (μ) thermo-EMF (S) and thermoelectric power ($S^2\sigma$)) condensates PbTe–Bi₂Te₃ (PbTe:Bi) conditions of their receipt (T_V , T_S , τ). Is confirmed that the average size of the islands in typical molecular beam epitaxy mode complete condensation bulk of the time grows proportionally $\tau^{1/2}$. It is shown that the dominant process is the Folmer-Weber formation of individual germ on the substrate. The growth of individual nanostructures caused Wagner mechanism (formation of chemical bonds) in the normal direction to the surface deposition and kinetic (diffusion) - in the lateral direction, respectively.

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