"Nanostructured surfaces"

Formations and transport phenomena in vapor-phase nanostructures of SnTe

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Tin Telluride refers to the number of materials for thermoelectric application, IR- and temperature sensors [1].

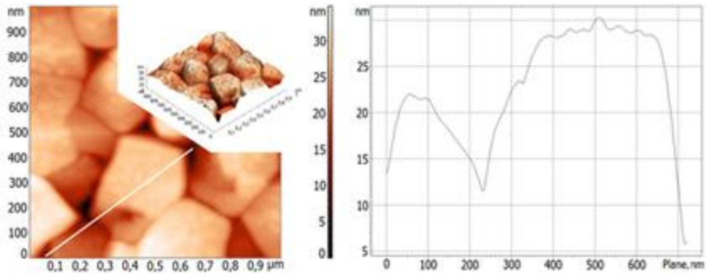
Films for the study treated by vapor deposition of synthesized material in vacuum on ceramics substrates. Evaporator temperature during deposition was Te = (720-970) K and the temperature of substrates Ts = (420-620) K. Film thickness asked of the deposition time in the range (5-360) p. These nanostructures were studied by methods of atomic force microscopy (AFM) on the Nanoscope 3a Dimentipon 3000 (Digital Instruments USA) in periodic contact. Measurements carried out in the central part of the sample using serial silicon probes NSG-11 with nominal radius of curvature of 10 nm (NT0MDT, Russia). As a result of AFM studies of vapor-phase condensates defined the surface morphologies and its profilographs.

Measurement of electrical parameters of the films were carried out in air at room temperature at constant magnetic fields on the developed automated facility that provides both the electrical parameters measurement process and registration and preprocessing the data with the possibility of plotting time and temperature dependences.

There is investigated the structure and thermoelectric properties of p-SnTe thin films with different thickness d = (40-810) nm which have been obtained by the condensation of the steam in open vacuum on the fresh chips (0001) mica-muscovite.

The heteroepitaxial growth of nanostructures formed by Folmer-Weber mechanism with individual clusters formation of the clusters next orientations: (100) and (111) SnTe ∥ (0001)-muscovite mica (see figure). The separate nanoformations has cube-like structures with lateral sizes that increase with time of deposition increasing.

Based on the statistical analysis of the experimental results have been gotten the increase of specific conductivity (σ), carrier mobility (μ) and a slight decrease both of the Seebeck coefficient (S), and hole concentration (p) with the growing condensate thickness (d).



a) b)

Figure. 2D and 3D AFM-image (a) and profilographs (b) of vapor-phase condensates SnTe/(0001) mica-muscovite after deposition time τ = 10 sec.

It received the thickness dependence of thermoelectric parameters of condensate thickness. There are determined the high Seebeck coefficient ($S \approx 70$) mV / K and the thermoelectric power ($S^2\sigma \approx 18$) $\mu W/K^2 cm$ that significantly higher than bulk crystals parameters.

It is shown that stable p-type conductivity and high holes concentration (10^{20}-10^{21}) cm^{-3} in vapor-phase non-stoichiometric condensate p-SnTe on the base of qrystal-chemical approximation caused by the completion of anionic sublattice and the formation of vacancies of Tin in crystal structure.

1. Freik D.M., Prokopiv V.V., Galushchak M.O., Pyts M.V., Mateik G.D. Crystal-chemistry and thermodynamics of atomic defects in AIVBVI compounds. Ivano-Frankivsk, Plai, 163 p. -2000.