THIN FILM STRUCTURES ON THE BASE OF DOPED LEAD TELLURIDE

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The increased interest in lead chalcogenides has been called by the theoretical predictions and experimental confirmation of the possibility of increasing thermoelectric figure of merit of superlattice. Found that their properties are determined by technological factors of the growth process and of the conditions of their subsequent using.

At the contact with oxygen on the film surface it is created a layer of p-type conductivity, so it become impossible to get a stable in time thematerial of n-type on the basis of pure lead talluride. Alloying yields a stable in time material of n-type conductivity.

It was studied the changes in kinetic parameters of the polycrystalline films of PbTe: Bi with different thicknesses (0,1-2,0) μm when exposed to air. In the range of a two-layer Petrits model it was found the dependence of the thickness of the surface layer and its formation rate on the exposition time in the air. The results are interpreted by the processes of adsorption and diffusion of oxygen.

Bi doping leads an active donor action in lead telluride, which is manifested in a significant increase of the concentration of electrons up to ~ 2 10^{20} cm^{-3}. Also, the films with thickness up to ~ 0.25 μm are characterized by high values of electrical conductivity (~ 250 $Ohm^{-1}cm^{-1}$) and the Seebeck coefficient reaches a value of 200 μV/K.

It was found that at exposition of films to air for the first day the thickness of oxidized layer is ~ 0.1 μm and subsequently changes slightly. Surface conductivity over this period is reduced by more than one-third and in the future also changes little. This leads to a significant decrease in conductivity only for thin film, and for samples with thickness greater than 0.3 μm conductivity practically does not change with time. The coefficient of the thermoelectric power when exposed to air remains almost constant too (fig.1). Thermoelectric power of thin films for the first day is decreased halved and subsequently stabilized at values which are higher onthe order from the thermoelectric power for thick films.

This can be explained by processes of oxygen adsorption by the film surface whichtake place at the early stages of exposure to air and by diffusion processes, which are much slower and virtually have no effect on the thermoelectric parameters of the condensate. This is confirmed by the calculations in Petritsmodel.

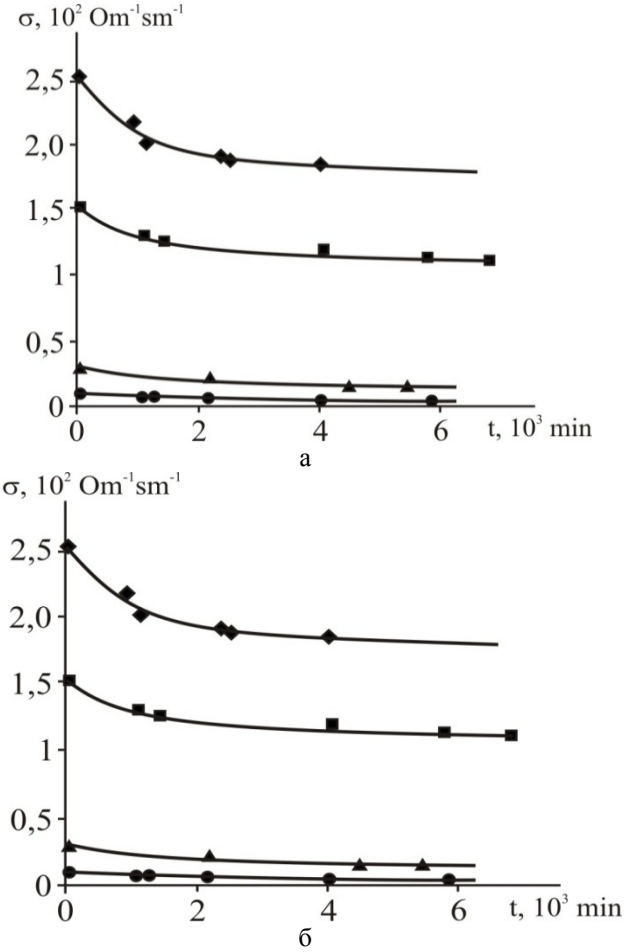

Fig. 1. Thedependenceoftheconductivity σ (a), Seebeckkoefitsiient S (b) from exposition time of the filmsPbTe:Bi in air for different thicknesses, μm: ♦ – 0,25; ■ – 0,27; ▲ – 0,34, ● – 1,08

Thus the high values of conductivity in combination with a large thermopower of doped films PbTe:Bi yielded stable over time thermoelectric material of n-type conductivity.

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