Energy

**INVESTIGATION OF THERMOELECTRIC PROPERTIES OF HETEROPHASE PbTe:Sb MATERIALS DEPENDING ON TECHNOLOGICAL FACTORS OF PRODUCTION AND ALLOYING**

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The projected population growth and economic development until the end of the 21st century will result in a more than threefold increase in global energy consumption. Considering this, as well as the global climate changes, there is a need to explore and develop energy-saving technologies for efficient renewable energy sources. Therefore, research focused on the direct conversion of thermal and solar energy into electricity is of utmost importance. The development of efficient technologies in this field can help utilize available energy sources more effectively and environmentally safely. This includes the development of new materials, energy conversion and storage technologies, as well as the improvement of existing systems. The overall direction of research aims to ensure a sustainable, clean, and affordable energy future. Additionally, the development of energy-saving technologies is an important component of the present day.

Thermoelectric generation is one of the promising and, in some cases, the only viable method for converting thermal energy into electricity. Unique thermoelectric generators have been developed based on thermoelectric phenomena, which are utilized in space, underwater, and terrestrial applications. Additionally, thermoelectric cooling is also employed in fields such as medicine, biology, electronics, and more.

At the same time, a significant drawback of thermoelectricity is the low efficiency of materials, which is determined by the thermoelectric figure of merit (ZT = 0.7-0.9). Therefore, the search for materials with higher ZT values, for example, 1.5-2.0, would enable widespread use of thermoelectric converters.

We conducted a comprehensive study of the thermoelectric properties and the defect subsystem of crystals and films of lead telluride (PbTe), which is one of the best thermoelectric materials for medium temperatures (450-800) K [1]. Their efficiency is determined by the figure of merit (ZT)Початок форми

**ZT=**$(\frac{α^{2}σ}{x})T$**,**

where α, σ, κ, T - respectively, the Seebeck coefficient, electrical conductivity, thermal conductivity, and absolute temperature.

The maximum ZT for PbTe is 0.7 at 700 K. There are various ways to increase ZT, achieved by increasing electrical conductivity (σ) and reducing thermal conductivity ($x).$ We have investigated the influence of antimony on the complex physicochemical properties of PbTe, which are used for thermoelectric elements in the temperature range of 500-800 K.

 Based on the research, it has been found that the donor effect associated with the introduction of antimony atoms into the crystalline lattice of PbTe is significantly less pronounced compared to the case of doping with PbTe:Sb (1 at.% Sb). This could be due to the possibility of forming not only substitutional donor-type defects ($Sb\_{Pb}^{1+}$), but also interstitial donor defects ($Pb\_{і}^{2+}$) during doping. Due to the higher carrier concentration compared to solid solutions, PbTe:Sb (1 at.% Sb) exhibits high electrical conductivity (σ) and a high thermal conductivity ($x$) coefficient. However, increasing the doping level to 8 at.% results in the precipitation of an additional phase of pure antimony, leading to a decrease in the thermal conductivity coefficient (x) and achieving a thermoelectric figure of merit (ZT) of 1.25 at 470 K, which is almost twice as high as that of pure lead telluride.Початок форми

Based on the analysis of the research results on the thermoelectric properties of Pb-Sb-Te-Ag materials, it has been justified that it is possible to create both n-type and p-type branches of thermoelectric converters with a high figure of merit (ZT) of 1.5-2.0.

1. Г.Т. Алексеева и др. Концентрация дырок и термо϶лектрическая ϶ффективность твердых растворов$ Pb\_{1-x}Sb\_{x}$Te (Te) / Физика и техника полупроводников. 2000. №8,Т34. С.935–939.