

**SYNTHESIS OF AlBiZnSnGa ALLOYS  
AND STUDY OF THEIR PROPERTIES***Lelyukh S.A., Ilinykh N.I., Gelchinsky B.R., Rempel A.A.*

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Alloys consisting of elements with a low melting point play an essential role in the development of next-generation low-temperature fusion technologies in microelectronics. This group of alloys, for the most part, are lead-free solders. Currently, publications have appeared on the production of wind turbines from low-melting elements [1]. In such alloys, a major role is played not by hardness or wear resistance, but by resistance to fatigue loads, plasticity, and adhesion to other metallic materials.

In the present work, the synthesis of the AlBiZnSnGa alloy is carried out, where the gallium content was 2 at.%, and the remaining components were taken in an equiatomic ratio (24.5 at.% each). When studying the microstructure of this sample, pronounced needle-like phases are found in the alloy structure. The microhardness of the alloy averages 34.747 kg/mm<sup>2</sup>. According to the XRD results, the main component of the alloy is Bi (33.4 wt.%). The content of tin and zinc is approximately the same: 20.9 and 20.1 wt.%, respectively. The aluminum content is 8.4 wt.%, gallium – 0.8 wt.%. In addition to pure metals, the intermetallic compound AlSn (3.0%) and the oxides Sn<sub>3</sub>O<sub>4</sub> (4.0%), SnO<sub>2</sub> (4.4%) and ZnO (5.0%) are formed.

Simultaneous thermal analysis (STA) was performed in an argon medium in the temperature range of 20–700°C, with a heating and subsequent cooling rate of 10 K/min, in Al<sub>2</sub>O<sub>3</sub> crucibles. On the DSC heating curve, the beginning of melting of the sample is characterized by an endothermic peak at 123°C. At a temperature of 140°C, the melting of more refractory compounds begins. The crystallization of the alloy begins at a temperature of 129°C. Several endothermic and exothermic peaks are observed on the heating and crystallization curves, the presence of which may be due to the formation of phases and the occurrence of eutectic, peritectic or monotectic reactions. The change in the mass of the sample during the study was 0.15%. The results of the analysis allow us to conclude that the melting point of the resulting alloy is significantly lower than that of all the initial components, except gallium.

1. Liu Y., Pu L., Yang Y., He Q., Zhou Z., Tan C., Zhao X., Zhang Q., Tu K.N. A high-entropy alloy as very low melting point solder for advanced electronic packaging // *Materials Today Advances*. September 2020. 7:100101. <https://doi.org/10.1016/j.mtadv.2020.100101>

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