Microstructure and Electrophysical Properties of Cu-Based Binaries of Multicomponent Bi–Cu–Ga–In–Sn Alloys

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Abstract. The concept of multicomponent high-entropy alloys is known, according to which high entropy of mixing can stabilize the formation of solid solutions (simple crystal structure of bcc, fcc) during solidification. Stabilization of the solid solution and prevention of the formation of intermetallic phases during solidification is provided by the high entropy of mixing in the solid and liquid states. High-entropy alloys have increased strength, high hardness, thermal stability in combination with good resistance to oxidation and corrosion. These properties allow to expand significantly the scope of these alloys. The high-entropy alloys must contain 3 or more elements (e.g., CuBiSnInPb, CuBiSnGaPb) in more or less equal proportions.

In this work, the viscosity, electrical conductivity and thermoelectric power of binary Cu–Bi, Cu–Ga, Cu–Pb, Cu–Sn, Pb–Sn, Pb–Bi, Bi–Sn and multicomponent Cu–Bi–Sn, Cu–Bi–Sn–In, Cu–Bi–Sn–In–Pb, Cu–Bi–Sn–Ga–Pb alloys of equiatomic concentrations, which are the sub-systems and components of model low-temperature multicomponent high-entropy alloys, have been studied experimentally in a wide temperature range including liquid and solid states. Based on the obtained results, the activation energy of the viscous flow and the entropy of mixing were calculated. The lack of the surface tension experimental data of the above mentioned alloys is compensated by the model predicted values. The negative values of the entropy of mixing suggest the structural ordering in the system.

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