PHYSICAL PROPERTIES OF Al-Ni-Co-Cu-Zr AND Al-Ni-Co-Fe-Cr HIGH-ENTROPY ALLOYS IN SOLID AND LIQUID STATES

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High-entropy alloys (HEAs) have been actively studied in recent years due to their high mechanical properties and corrosion resistance. A distinctive feature of these alloys is the formation of a solid solution as a result of the relatively high entropy of mixing of the components. HEA are promising materials for various industries. Despite this, the physical properties of HEA, especially at high temperatures and in liquid state, are practically unexplored to date. In this work, density, electrical resistivity, viscosity and magnetic susceptibility of Al-Ni-Co-Cu-Zr and Al-Ni-Co-Fe-Cr HEAs with different component ratios are investigated for the first time.

Al-Ni-Co-Cu-Zr and Al-Ni-Co-Fe-Cr alloys were obtained from pure initial components in an induction furnace at a maximum temperature of 1800 K in a protective helium atmosphere. Density of the alloys was measured on an automated set-up using the gamma-absorption method. Electrical resistivity was studied using contact-less method in a rotating magnetic field, magnetic susceptibility was studied using the Faraday method, and viscosity of the melts was studied using the damped torsional vibrations method. All experiments were carried out in a protective helium atmosphere at temperatures ranging from 300 up to 1800-1900 K.

It is shown that the investigated compositions are characterized by a practically linear decrease in density during heating and in liquid state their density can be described by linear functions. The temperature dependence of viscosity of melts can be described by the Arrhenius equation at high temperatures. In AlNiCoCuZr alloys, an anomalous decrease in electrical resistivity and a corresponding increase in magnetic susceptibility were found in the temperature range of 800–1000 K. The results of high-temperature diffraction experiments show that these anomalies are associated with structural changes in the composition of the alloys.

The obtained results can be used to optimize the preparation modes of Al-Ni-Co-Cu-Zr and Al-Ni-Co-Fe-Cr HEAs for quenching and to obtain finished products based on them.