EXPERIMENTAL STUDY OF THERMOPHYSICAL PROPERTIES AND PHASE TRANSITIONS OF METALS AND ALLOYS IN SOLID AND LIQUID STATES

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In this report, we present the results of experimental study of thermophysical properties and phase transitions of solid and liquid metals and alloys based on alkaline and rare-earth elements over wide temperature ranges. Measurements of the density and coefficient of mutual diffusion (293–2000 K) were performed by the gamma-method, thermal expansion (110–1800 K) by the dilatometer method, heat capacity (200–1200 K) by the DSC method, increment of enthalpy (420–1300 K) by the mixing method, thermal conductivity and thermal diffusivity (293–1770 K) by the laser flash method. The description of experimental installations and measurement procedures is given. The properties of pure Li, Na, K, Rb, Cs, Mg, Pb, Bi, Sn, In, Ni, La, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er; magnetic materials based on Nd–Fe–B and Sm–Co; liquid systems of Li–Pb, Na–Pb, K–Pb, Rb–Bi, Cs–Bi, Li–Mg, Li–La, Mg–Pb were investigated.

For all the materials studied, the temperature dependences of the properties were obtained, changes of the properties in the regions of phase transitions were determined, references tables were developed and their errors were estimated. The phase diagrams of binary systems were refined. It was shown that the critical exponents of the thermal coefficient of linear expansion are positive, they have different values above and below the points of magnetic transformations and substantially exceed the critical heat capacity exponents in absolute value. It was found that the concentration dependences of the properties for certain component ratios deviate strongly (up to 50%) from the laws of the ideal solution. This indirectly confirms the presence of associated complexes (with a partially ionic character of the interatomic bond) in the liquid state, which gradually break down with increasing temperature.

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