

Direct measurements of free surface energy in two-component solid metallic systems

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The methods and results of direct measurements of surface energy in two-component Cu-based and Ag-based solid solutions are presented. The measurements were carried out in situ in a wide range of temperatures and concentrations [1]. The concentration of solid solutions in some cases reached the solubility limit.

It has been experimentally shown that the isotherms of the surface energy of solid solutions can have a complex behavior (with maxima and minima). Features on isotherms are associated with surface phase transitions [2].

Two types of surface phase transitions are detected: phase transitions of the formation of thermodynamically stable liquid films of nanometer thickness (Cu (Ag), Cu (Pb)) and phase transitions of the formation of ensembles of particles (Cu (Co), Cu (Fe)).

In Ag-Cu system, the surface energy isotherms of both solid solutions were measured. It is shown that the behavior of surface energy with temperature and composition is fundamentally different for solid solutions based on Ag (Cu) and solid solutions based on Cu (Ag).

Simultaneously with the measurement of the surface energy, the diffusion creep rate was measured. It turned out that the diffusion creep rate depends strongly on the phase state of the surface. This makes it possible to reliably determine the conditions of formation and the type of surface phase transitions [3].

References:

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