CORRELATION OF ELECTRICAL RESISTANCE AND THERMAL EXPANSION OF INTERMETALLIDE TI_3AL

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The anomalous behavior of the electrical resistivity of the intermetallide Ti_3Al is studied, which consists in the fact that its temperature coefficient (TCR) is of a semiconductor nature. This behavior of TCR for conductors is associated with high static disorder. To determine the nature of the features of the properties of this intermetallide compound, we investigated the temperature dependences of the electrical resistivity and the of thermal expansion coefficient (TEC). The sample was obtained by induction melting of pure titanium and aluminum, cooling was carried out in the same furnace after it was turned off. Precision measurements of the electrical resistivity by a four-probe method were performed with current switching from room temperature to 1000^oC. Simultaneously, on the same sample, under the same conditions, was measured its thermal expansion by the quartz dilatometer method.

We made four cycles of heating and cooling the sample. In the first heating, the temperature dependence of the resistance exhibits a hysteresis, which was significantly reduced in subsequent cycles. The disappearance of the hysteresis effect indicates that the system has reached a stabilized state. Features on the temperature dependences, both TEC and electrical resistance are manifested. They are most clearly visible for the electrical resistivity. This is due to competition and the dominance of the metallic and semiconductor conductivity characters at each of the temperature intervals.

It is established that the anomalies in the temperature dependences of the resistance and the TEC correlate, and this correlation is direct, as for traditional metals. This indicates the decisive role of the change in the interatomic distance associated with the anharmonicity of lattice vibrations, not only in the formation of the scattering potential of elementary charge excitations, but also in the formation of charge excitations themselves. Local disordering of atoms in the unit cell Ti_3Al after the corresponding heat treatment makes it possible to control the absolute values of the electrical resistivity of this intermetallic compound and its temperature coefficient.

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