THE INFLUENCE OF SMALL ADDITIONS OF NI, CO, FE ON THE VISCOSITY OF LIQUID ALUMINUM

Beltyukov A.L.,* Menshikova S.G., Lad'yanov V.I., Korepanov A.Yu.

UdmFRC UB RAS, Izhevsk, Russia
**albeltyukov@mail.ru*

Viscosity is one of the most structurall-sensitive properties of melt and measurements of its temperature and concentration dependences are often used in the study of the structure of liquid alloys and the analysis of interparticle interaction in them.

Temperature and concentration dependences of melts viscosity of Al-Ni, Al-Co and Al-Fe systems with the content of the second element up to 10 at.% have been studied in this work.

For liquid aluminium and melts of Al-Ni, Al-Co, Al-Fe systems with low content of alloying element (up to 1.0 at.% Ni and up to 1.4 at.% Co and Fe) the deviation of viscosity temperature dependences on Arrhenius dependence due to structural transformation in liquid aluminium was found.

An increase in the content of the alloying element leads to an increase in the melt viscosity for all three systems. For the Al-Ni system, the viscosity concentration dependence is nonmonotonic with a maximum near 1.5 at.% and a minimum in the range 2-2.7 at.% Ni. Isotherms of the viscosity of Al-Co and Al-Fe systems are monotonic.

The found features of temperature and concentration dependences of melt viscosity are explained by the formation of clusters from atoms of different sort and the dependence of their composition on the content of the alloying element. Clusters consisting of an atom of the alloying element (AE) and surrounding Al atoms (cluster Al(AE)) are formed in the melt at low concentrations of the alloying element. With an increase in the alloying element content, an increase takes place in the Al(AE) cluster quantity as well as a decrease of the volume part of the melt with the short range ordering characteristic for the liquid aluminum itself. With further alloying, after achieving a particular concentration of the AE atoms in a certain local melt domain, larger clusters occur with short range ordering close to the intermetallic compound. In the Al-Ni system, it can be an Al_3Ni compound.

The work was performed as part of the state task of FASO of Russia (state registration number AAA-A17-117022250039-4).