Nanoobjects microscopy

Age-hardening process of anomalous supersaturated solid solution of Al-Mg-Sc-Zr alloy

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Earlier in our study [1,2] we have shown that the decomposition in the bulk samples of the Al-Mg-Sc-Zr-Hf alloy solidified with the cooling rate of $10^2 – 10^3$ ºC/s occurs continuously with the formation of nanocomposite heterophase strengthening Al_3Sc/Al_3Zr particles of the core/shell type. The formation of Al_3Zr shell changes the nature of the interfacial fit of the particle with the matrix and slows down the decomposition during the coalescence stage, which improves the thermal stability of alloys.

The aim of the study was to obtain the anomalous supersaturated solid solution of Al-Mg-Sc-Zr alloy rapidly quenched with the cooling rate of $10^5 – 10^6$ ºC/s and to examine the kinetics and morphology of the precipitation of nanocomposite strengthening phase particles depending on the Sc/Zr ratio.

Al-(3,5-4)at.%Mg-(0,25-0,5)at.%Sc-(0,15-0,75)at.%Zr alloys with the ratio of Sc/Zr= 5; 2; 1; 0,3 were chosen in the study. The alloys were obtained by the melt-spinning method at the quenching temperature of 1000ºC. The annealing at the temperature range of 300-450^{0}C was carried out to study aging processes in the Al-Mg-Sc-Zr alloys. The structure and mechanical properties of the alloys were studied using transmission electron microscopy, X-ray diffractometry and hardness measurements. The temperature intervals of the phase transformations were determined by measuring the temperature coefficient of resistivity $_t=1/_0\ d/dT$.

The temperature ranges for the core and shell formation of strengthening particles were determined. It is shown that the highest thermal stability of the alloy is achieved when the Sc/Zr ratio equals 1.

1. *Berezina A.L., Monastyrska T.O., Molebny O.A., Kotko A.V.*. Al_3Sc/Al_3Zr Composite Particles Formation in Deformed Al-Mg alloys // Aluminium Alloys: Their Physical and Mechanical Properties, Edited by Jurgen Hirsch, Birgit Skrotzki and Gunter Gottstein.-2008.-P. 1034 – 1039.