Ostwald Ripening of Nanodispersed Phases in Metal Alloys

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Recently, due to the development of nanotechnology, there are significant deviations from the classical theory of Lifshitz-Slyozov-Wagner. An example of such deviations are many experimental works in which it is shown that the experimental particle size distribution obtained by chemical methods are not described the theoretical curve Lifshitz-Slezov and is not satisfied dependency $\langle r \rangle \sim t^{1/3}$. This means that in this example the experimental studies when the synthesis of nanoparticles (NPs) is performed by chemical methods, diffusion mechanism of NPs growth does not work.

In [1] was developed the modified theory of Lifshitz-Slyozov-Wagner for systems in which the growth of the particles is controlled by both diffusion and the rate of formation of chemical bonds or chemical reaction. At the same time, however, the question arises, how to be in the case of metallic systems in which growth can occur in clusters under the dislocation diffusion, ie, diffusion along of individual dislocations or dislocation tubes?

With this in mind, we have studied the growth (dissolution) mechanism of the nanoparticles is controlled simultaneously matrix diffusion, diffusion along dislocations and the rate of formation of chemical bonds in metal alloys systems $CuNiAl$ or $AlLi$, at the stage of Ostwald ripening (OR). Obtained the expression for distribution function of nanoparticle size, based on the calculation of which is dependent on the rate of growth of three fluxes - diffusion j_υ, dislocation j_d and kinetic j_i.

Theoretically calculated distribution quite adequate describes the experimental histograms in alloys $CuNi_{15}Al_5$ or $Al-Li$.

It means that the proposed mechanism of clusters growth in the process of OR, when taking into account all three fluxes j_υ, j_d or j_i, can be realized in practice, and the calculated distribution can be used to compare with experimental histograms to establish possible mechanisms of growth.

1. Vengrenovich R.D., Ivanskii B.V., Moskalyuk A.V. Generalized Lifshitz-Slyozov-Wagner distribution // JETP. – 2007, – Vol. 131, №6, – P. 1040-1047.