Formation of the Primary Nanocrystalline Phases in a Non-equilibrium Crystallization Conditions of Light Lanthanides With Silver Alloys

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By radiographic investigations of the structure of alloys $E_{100-x}Ag_x$ (E – La, Ce, Pr) depending on the composition (x = 0 – 50 at.%) and the quenching of the liquid state rate ($\upsilon_- = 5\cdot10^4 – 6\cdot10^7$ K/s) identified the concentration ranges of detection and thermal modes of metastable nanocrystalline structures of two types formation. It is shown that in alloys with silver content x = 10 – 35 obtained by rapid quenching at a cooling rate $\upsilon'_к \le \upsilon_- \le \upsilon_к$ crystallizes the metastable bcc-phase of initial chemical composition with the grain size of ~ 30 – 50 nm. In the slow cooling conditions ($\upsilon_- \le \upsilon'_к$) the alloys retains the equilibrium phase composition, elements of which are close-packed modifications of the main component and equiatomic compound E-Ag with the CsCl-type of lattice. When the process accelerating ($\upsilon_- > \upsilon_к$) crystallization is suppressed and the amorphous state is fixed. For all investigated alloys experimentally established the critical cooling rates $\upsilon'_к$ and $\upsilon_к$.

First obtained and identified the diffraction patterns of X-ray amorphous phases formed in the concentration range of x = 5 – 7 at the extreme conditions of the melt quenching ($\upsilon_- \approx 6\cdot10^7$ K/s). It was found that these structures are nanocrystalline (5,5 – 7,0 nm) compounds of a fcc-modifications of the rare-earth elements and metastable bcc-phase containing ~ 10 at.% Ag.

The correctness of the X-ray studies results is confirmed by the theoretical analysis of the structure formation processes of rapidly quenched alloys $E_{100-x}Ag_x$, performed within the concept of kinetic diagrams "temperature-time-transformation".