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FORMATION OF NANOSCALE CLUSTERS IN FCC ALLOYS UNDER SEVERE PLASTIC DEFORMATION

It is well known that severe plastic deformation as well as radiation generates a great number of point defects. Motion of point defects toward sinks (dislocations, grain and subgrain boundaries of grains, interfaces) can induce «stratification» of γ-solid solution. It is not clear beforehand, if this process occurs in the course of deformation because dislocation motion results in equalization of alloy composition, not in stratification, contrary to point defects.

Thereby, the aim of the present work was investigation of redistribution of doping elements and possible stratification in the Fe–Ni–Cr based fcc alloys under severe plastic deformation (SPD).

To detect this phenomenon by magnetic methods, we selected the compositions of the tested alloys with explicit composition dependence of magnetic properties, particularly. This choice allowed analysis of deformation redistribution of doping elements with using the data about evolution of T_C and other magnetic characteristics in the course of SPD.

The following results were obtained in the work. Process of atom stratification of the $Fe_{58}Cr_{12}Ni_{30}$ and $Fe_{48}Cr_{12}Ni_{40}$ (mass%) alloys under SPD at room temperature was found. Particularly, it was demonstrated that the intensity of increase in nickel concentration and related iron depletion in clusters of the size more than ~ 10 nm is about 2.5% per unit of logarithmic deformation. In the course of SPD, the part of clusters with the composition differing from the matrix by more than 5% reaches 10% of the volume.

Keywords: fcc alloys, severe plastic deformation, stratification, ferromagnetic clusters

Fig. 1. Specific magnetization σ of the $Fe_{58}Cr_{12}Ni_{30}$ alloy at 24°C: *а* – vs magnetic field magnitude *H* after varied cold deformation *e*: *1* – 0, *2* – 0.7, *3* – 1.6, *4* – 2.0, *5* – 3.1, *6* – 3.8, *7* – 6.0, *8* – 6.7, *9* – 7.4, *10* – 8.1, *11* – 8.8, *12* – 9.4; *б* – vs cold deformation degree *e* (*H* = 2.6 kOe)

Fig. 2. Specific magnetization σ of non-deformed (–■–) and deformed at *e* = 1.6 (ε = = 97.7%) (–◆–) samples of the $Fe_{58}Cr_{12}Ni_{30}$ alloy in magnetic field *H* = 2.6 kOe at 24°C vs the temperature of successive anneal in 50°C for 30 minutes

Fig. 3. Temperature dependence of specific magnetization σ of the $Fe_{58}Cr_{12}Ni_{30}$ alloy in magnetic field *H* = 2.6 kOe after severe plastic deformation *e*: –◆– – 0, –■– – 3.1, –▬– – 5.8, –△– – 6.5, –×– – 7.2, – ∗ – – 7.9, –●– – 8.8, –|– – 9.2