

# Nanoobjects microscopy

## The structure formation of film systems based on Gd, Fe and their compounds

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Films of binary compounds of Gd-Fe system and three-layer Fe/Gd/Fe/S film system were obtained by means of a thermal vacuum evaporation of polycrystalline mix material of a corresponding composition. The films with by thickness of 5-50 nm. were evaporated on splitting of NaCl, then NaCl dissolved in water. The part of films was picked up at once on copper electron diffraction grids. The temperature of substrates had two values 300 and 500 K. For structural investigation the electron microscope UEMV-100K and high-temperature attachment PRON-2 were used. Angle dependence of atomic factors of electron scattering was considered by atoms of gadolinium and iron.

Films of  $\text{GdFe}_2$  compounds condensed in structural type  $\text{MgCu}_2$ . This structural type is also in structure of massive samples.  $\text{Gd}_2\text{Fe}_{17}$  films which condensed at temperature of a substrate  $T_s = 500\text{K}$  consisted of an intermixture of three compounds – hexagonal  $\text{Gd}_2\text{Fe}_{17}$  with structural type  $\text{Th}_2\text{Ni}_{17}$ , rhombohedral  $\text{Gd}_2\text{Fe}_{17}$  with structural type  $\text{Th}_2\text{Zn}_{17}$  and hexagonal  $\text{GdFe}_5$  with structural type  $\text{CaCu}_5$ .

Positions of diffraction peaks has not changed. It testifies that the generated structures have not changed in due course, and also oxidizing process is not observed. If to compare intensity of maximums it is possible to observe insignificant disproportionation of phases content. The content of hexagonal  $\text{Gd}_2\text{Fe}_{17}$  compound has decreased (60%50%). The content of rhombohedral  $\text{Gd}_2\text{Fe}_{17}$  compound it was reduced (30%40%). The only phase which has not changed the percentage is hexagonal  $\text{GdFe}_5$  (10%).

In films Gd in the thickness 10 nm. there are less quasiamorphous phase is fixed. At magnification of a thickness of one-globe films from 10 to 50 nm. crystallisation processes start to be observed. After condensation, films of Gd have phase composition  $\text{Gd} + \text{GdH}_2$  and also small amount  $\text{Gd}_2\text{O}_3$  is observed. Annealing at temperature 800K not strongly influences change of a phase state. The inappreciable magnification of an oxide-coated phase is observed. The phase composition of three-globe films Fe/Gd/Fe/S does not differ from a phase composition of one-globe films. Except for that fact that oxide-coated phase  $\text{Gd}_2\text{O}_3$  starts to be fixed only after annealing.