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In Situ Neutron-Diffraction Studies of Structural Phase Transitions in Fe-xGa Alloys

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It is already well known that Fe-Ga alloys possess increased values of the magnetostriction constant. This characteristic has been studied in a wide range of gallium concentration (up to 35 at.%) [1, 2] and the presence of two peak of magnetostriction at 19 and 27 at.% of gallium has been established. At present, work is underway to analyze the influence of certain structural phases on the magnetostrictive properties of Fe-Ga alloys, including the influence of metastable pseudocubic phases, which can form already at gallium concentration of 27 at.% [3]. Therefore, the identification of general regularities of metastable phases and their transition to equilibrium phases is an important step in the development of the scientific basis for the formation of the optimal structural-phase state of Fe-Ga alloys in terms of their functional characteristics.
The use of neutron diffraction eliminates the influence of surface effects and local inhomogeneities of the structure on the experimental data. Also, the possibility of studying samples of large sizes minimizes the influence of coarse-grained structure on the diffraction patterns. Therefore, neutron diffraction is a very effective method for studying phase transitions in Fe-Ga alloys. In addition, the High-Resolution Fourier Diffractometer (IBR-2 pulsed reactor in JINR, Dubna, Russia) and General Purpose Powder Diffractometer (China Spallation Neutron Source, Dongguan, China) used by us made it possible to carry out in situ experiments with the data acquisition rate at the level of several minutes. This allowed us to analyze in detail the structural changes during continuous heating and isothermal exposures.
In situ comparative studies of the phase composition evolution during continuous heating of the Fe68Ga34 alloy, characterized by different initial states, were carried out. In addition, the kinetics of phase transformations in this alloy was studied under conditions of long-term isothermal exposure at temperatures of 360-600 ℃. Details of the experiments and obtained results will be presented in the report.

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