Flooding of massive samples and thin films of the Gd-Fe system

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In materials science, a new tend of chemical and thermal treatment of metals is intensively developing, which consists in the use of hydrogen as a technological environment in the process of processing functional materials. Such hydrogen technologies are based on the laws of the influence of hydrogen on phase transformations in metals, including polymorphism, atomic ordering and the formation and decay of intermetallic phases and hydrides. A known process that affects the formation of the phase-structural state of the material is HDDR (hydrogenation, disproportionation, desorption, recombination). If you complete the HDDR process at different stages, you can get very different results.

The Gd-Fe_2 compounds and films and two flood schemes were used for the study – 1) The crushed Gd-Fe_2 samples were under a pressure of $2x10^6$ Pa for 168 hours at room temperature. 2) The crushed samples of Gd-Fe_2 were under a pressure of 10^6 Pa for 30 minutes at temperatures of about 700K. In the first case, hydrogen penetrated the lattice, deforming it. The amount of absorbed hydrogen depends on how finely ground our powder, in the case of thin films, the amount of absorbed hydrogen increases sharply compared to the mass of the "absorber". Electrographic studies of films before and after flooding indicate that such films have become finer (Fig.1,2). The flooding parameters for the second method are shown in Fig.3. When heating the flooded samples, the reverse process of hydrogen evolution was observed, as evidenced by chemical analysis of the air in the heating chamber. It is possible to use such multi-layered structures to create hydrogen batteries. In the second case, hydrogen reacts with Gd-Fe_2 to form GdH_2 and GdH_3 plus free Fe. As evidenced by the destruction of the sample (turned into powder) and diffraction studies (Fig.4). Unfortunately, the second method is not very productive for films. But such hydrogen treatment can be used to influence the magnetic properties of the obtained powders, because it forms an anisotropic structure of magnetic materials.

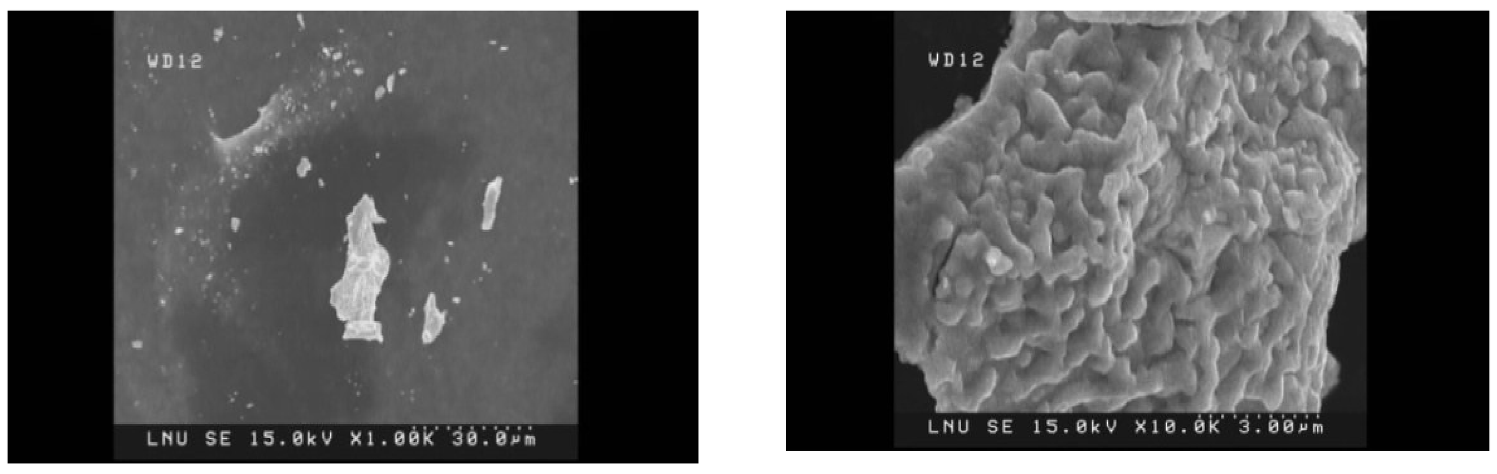

Fig.1 Photomicrograph of massive GdFe2 before flooding at x1000 and x10000 magnifications

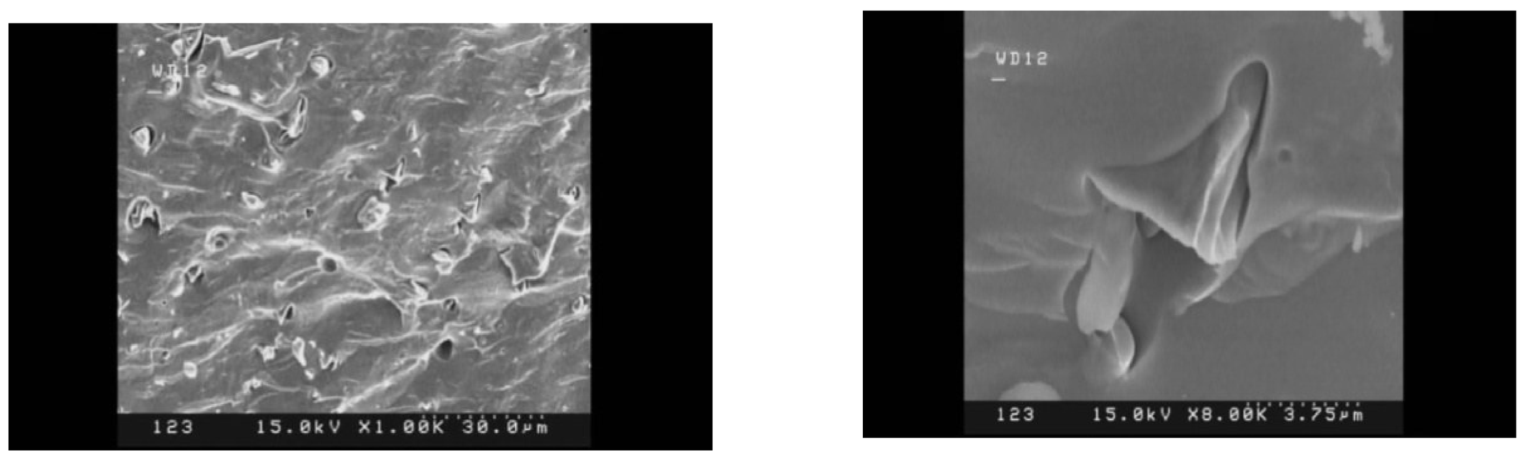

Fig.2 Photomicrograph of massive GdFe2 after flooding at x1000 and x8000 magnifications

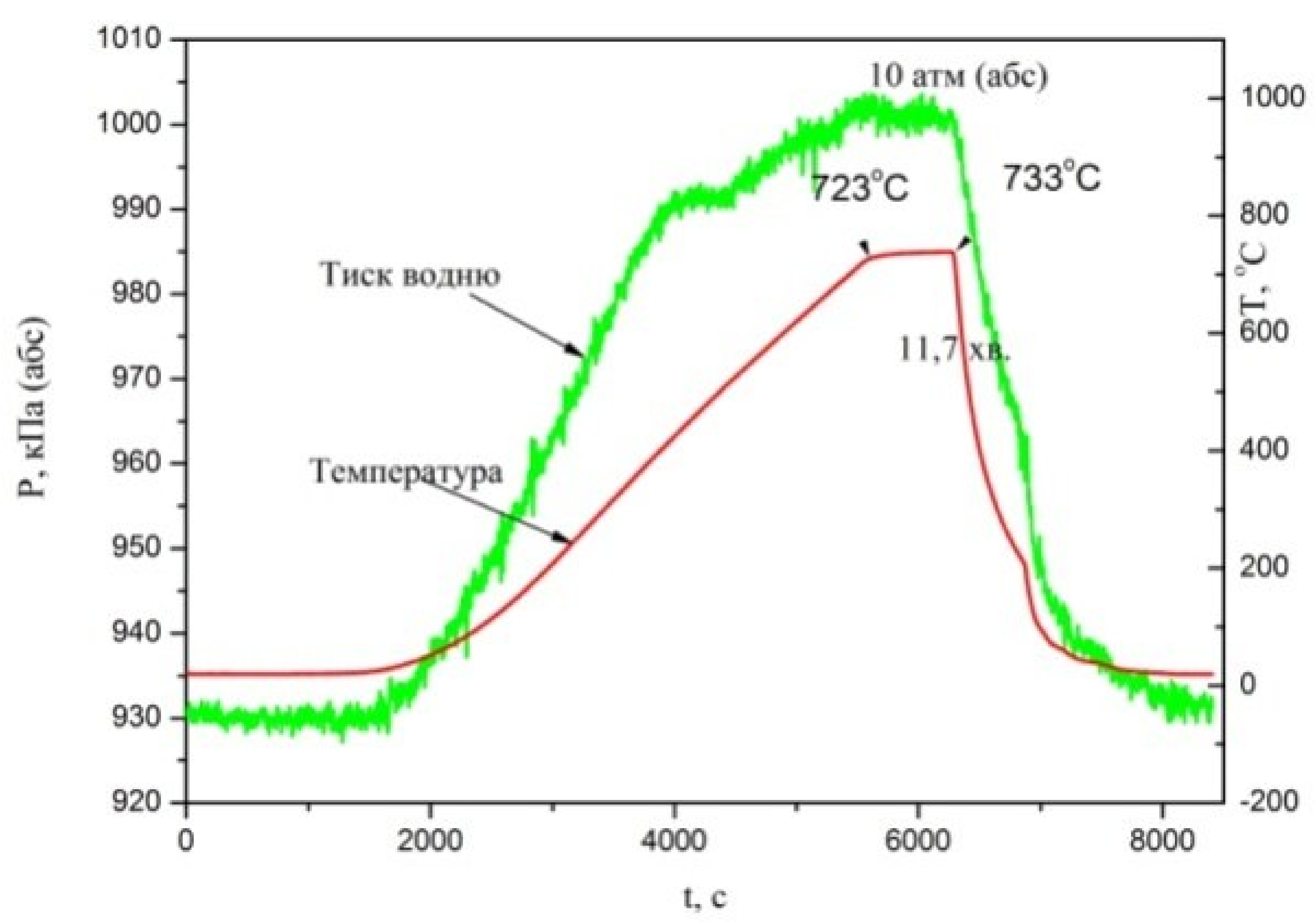

Fig.3 Parameters of flooding of films and massive samples

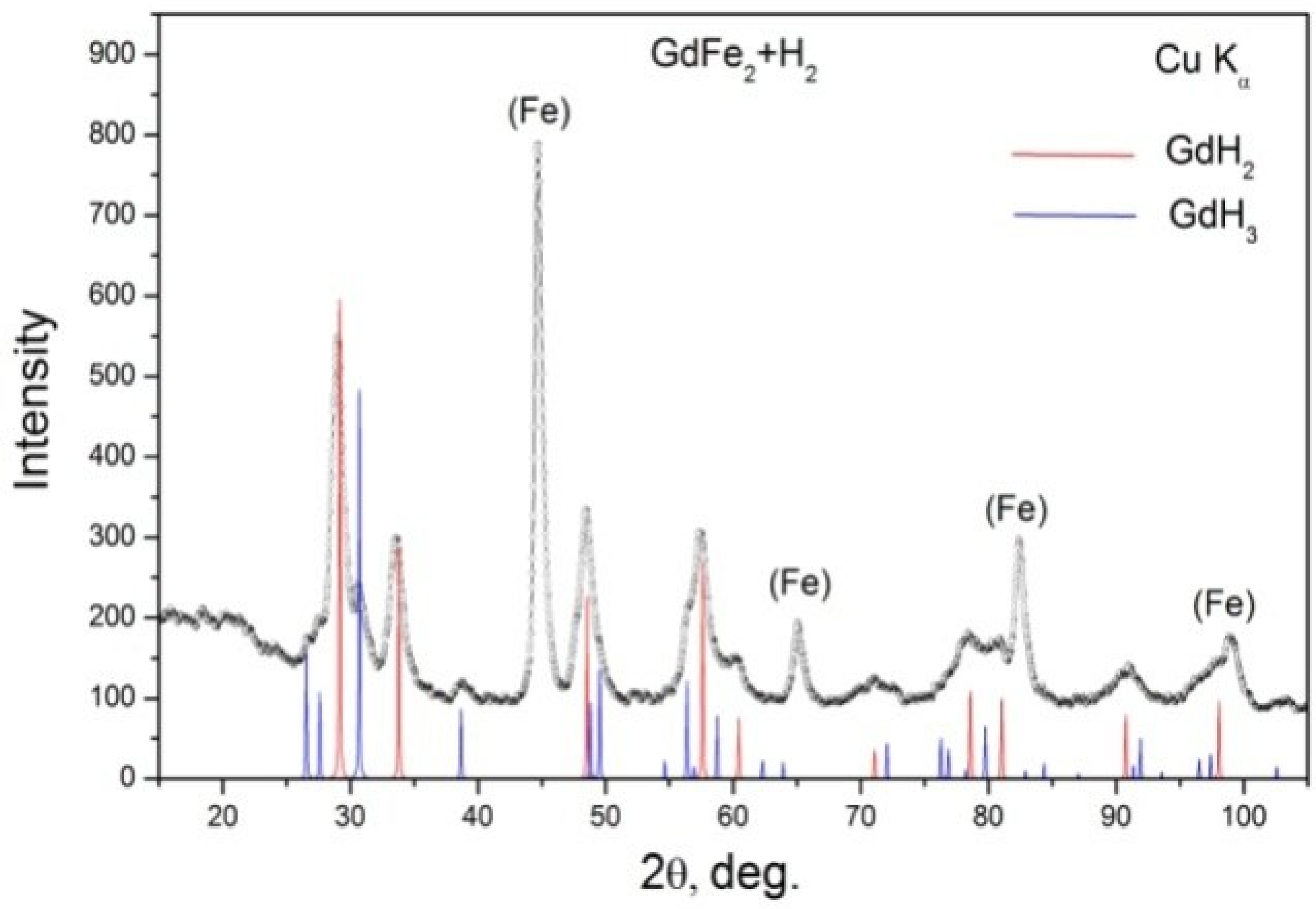

Fig.4 X-ray pattern of GdFe2 after flooding at a temperature of 700C