Supplementary information of the experimental setup.

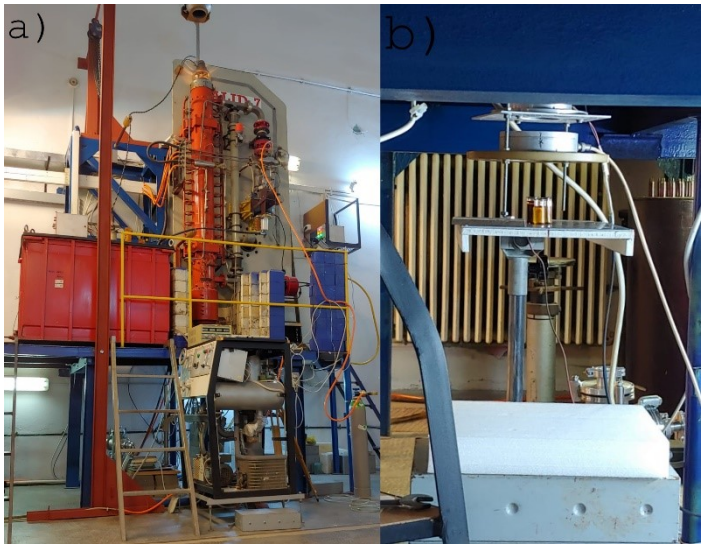

Fig. S1 a) Linear electron beam accelerator, ALID-7 (5.5 MeV, 4 μs pulse, with 50Hz repetition rate), b) experimental irradiation setup.

Supplementary information about the interpretation of XRD results.

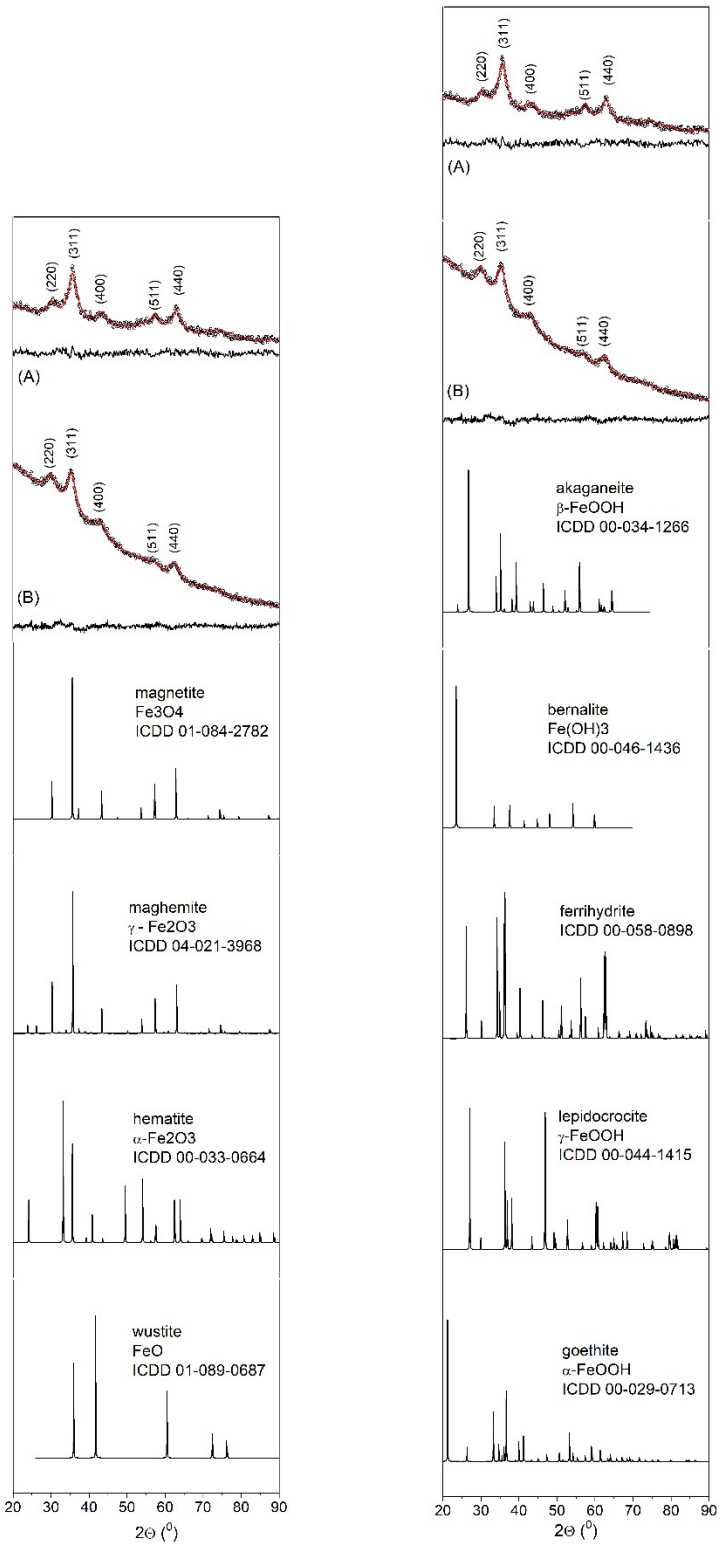

Fig. S2 Rietveld refinements of the XRD data for sample (A) and sample (B) and the diffraction patterns reported in ICDD database for iron oxides (left side) and iron oxyhydroxides and hydroxides (right side).

Supplementary information on the estimation of the magnetic moment of the nanoparticle.

In the Langevin formula, the magnetic moment of the nanoparticle, μ, was expressed as a magnetic moment per formula unit (f.u.) multiplied by the number of formula units present in a particle of mass ρV. If the usual value of 5.2 g/cm3 is taken for magnetite as well as a value of 55 emu/g for the spontaneous magnetization (i.e obtained by multiplying the saturation magnetization at 10 K obtained by the law of approach with a factor of 1.1 to disregard the influence of the 10% of antiferromagnetic oxyhydroxide phase), an average value of 2.3 μ_B per f.u. is obtained. Accordingly, a spontaneous magnetization of 288 emu/cm3 is obtained and μ can be expressed as μ[emu]=288*V with V provided in cm^3 . To note that the value of 2.3 μ_B per f.u. of magnetite is much lower than the theoretical one of 4 μ_B per f.u. corresponding to an ideal magnetic structure and therefore is considered as an average representative value over the whole volume of the nanoparticle with a real progressive magnetic disorder tpward the nanoparticle surface.