

Study of Hyperthermia Through the Bioplasma Treatment and Magnetic Properties of Fe₃O₄ Nanoparticles

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Fe₃O₄ nanoparticles were prepared by the high-temperature thermal decomposition method. Based on the Rietveld refinement, the crystal structure was determined to be a cubic spinel with space group of *Pnma*. The size and the shape of the nanoparticles were examined using a high-resolution transmission electron microscope (HR-TEM). Also, the Fe₃O₄ nanoparticles were treated with argon plasma and compared with untreated Fe₃O₄ nanoparticles. The X-ray diffraction patterns and HR-TEM images show small structural changes. Also, when exposed under Ar plasma, the saturation magnetization of nanoparticles exposed for 30 min was 73.705 emu/g, highest among the samples studied. The self-heating temperature of the sample increases up to 94.6 °C after the plasma treatment for 30 min. In addition, Mössbauer measurements were performed with a high external field of 5 T and based on the detailed analysis of the Mössbauer spectra, the spin canting angles in Fe₃O₄ nanoparticles were determined.

Index Terms—Fe₃O₄, hyperthermia, Mössbauer spectroscopy, nanoparticle, plasma treatment.