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E-MRS 2011
Spring Meeting

Bilateral Energy Conference
Acropolis Congress Center
Nice, France

May 9 – 13, 2011

INTERNATIONAL UNION OF MATERIALS RESEARCH SOCIETIES

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16:00

The changes in ferromagnetic coupling on iron oxide nanoparticles with Mössbauer spectroscopy

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Resume : The high temperature thermal decomposition method was used to synthesize iron oxide, Fe_3O_4, nanoparticles. The prepared nanoparticles were irradiated by proton beam with 0, 10 and 20 pC/μm^2, in order to investigate the changes of magnetic properties. The Rietveld refinement method was used to analyze x-ray patterns. It shows that the crystal structure is cubic spinel with space group of *Fd3m* and the lattice constants decreased from 8.3908 to 8.3701 Å with increasing proton irradiation. Also, the saturation magnetization (M_S) at room temperature was decreased from 57.2 to 53.7 emu/g with increasing proton irradiation. The Mössbauer spectrum at room temperature for non-irradiated nanoparticles shows the superparamagnetic behavior. However, The Mössbauer spectra for 10 and 20 pC/μm^2 irradiated nanoparticles show 6 absorption lines of ferromagnetic behavior. It can be explained that the proton irradiation induces the changes of ferromagnetic coupling between Fe^{3+} and Fe^{2+} ions.

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