The effect of proton irradiation on magnetic properties of lithium ferrites

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The effect of proton irradiation on magnetic properties of lithium ferrites has been investigated with x-ray diffraction (XRD), magnetization, and Mössbauer spectroscopy measurements. $Li_{0.5}Fe_{2.5}O_4$ powders have been fabricated by the sol-gel method. Following the annealing at 700 °C, these samples have been proton irradiated with 1, 5, and 10 $pC/\mu m^2$. The analysis of XRD patterns by Rietveld refinement method shows that these samples have ordered cubic spinel structures with space group of $P4_332$. We have observed that the corresponding lattice constant a_0 linearly increases from 8.3301 to 8.3314 ± 0.0001 Å with increasing proton irradiation. Compared to nonirradiated sample, which has the saturation magnetization (M_s) of 66.4 emu/g and oxygen occupancy of 3.9980 at room temperature, the values of magnetization and oxygen occupancy at room temperature are 66.0, 62.6, and 60.8 emu/g and 3.9840, 3.9452, and 3.9272, respectively, for 1, 5, and 10 $pC/\mu m^2$ irradiated powders. Also, the coercivity (H_c) decreases from 175.6 to 154.0 Oe with increasing proton irradiation. The Mössbauer spectra taken at room temperature show that the values of isomer shift (δ) for the tetrahedral (A) and octahedral (B) sites are consistent with the Fe^{3+} valence state. The results suggest that the proton irradiation induces the oxygen vacancy defects, which in turn leads to the changes in magnetic properties. [DOI: 10.1063/1.3070611]