Effect of Thermal Neutron Irradiation of $CoLa_xFe_{2-x}O_4$ Nanoferrites: XRD, FTIR, UV, VSM, and ESR Spectroscopy

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The structural and magnetic properties of $CoLa_xFe_{2-x}O_4$ (x= 0.0 and 0.06) spinel ferrites were studied before and after thermal neutron exposure. Polycrystalline $CoLa_xFe_{2-x}O_4$ ferrites were synthesized using the co-precipitation route. The samples were irradiated by thermal neutrons using a rabbit system for different times, i.e., at different doses. X-ray powder diffraction (XRD) revealed the formation of the cubic spinel phase. Interestingly, with longer irradiation times, i.e., higher absorbed doses, the strength of the peaks compared to spinel phase peaks diminishes. This was confirmed by Fourier-transform infrared (FTIR) spectroscopy, whereas the elastic moduli and Debye temperature were obtained. For UV spectroscopy, the energy gap increase is mainly related to the decrease in particle size values due to the quantum confinement size effect. As for the magnetic properties, they are dependent on the dosage radiation, and this is confirmed by VSM and ESR measurements.

Sample	**Dose (Gray)**	**a (Å)**	**R(nm)**	**δ (nm^{-2}) ×10^{-3}**	**Energy gap (eV)**	**M_s (emu/g)**	**H_{ci} (G)**
X=0.0	0.00	8.354	23.19	1.786	1.3	53.82	899.7
	11.5	8.358	23.574	1.799	1.337	62.629	789.1
	23	8.331	23.573	1.799	1.349	64.4	859.4
	34.5	8.319	17.918	3.115	1.352	63.27	189.8
X=0.06	0.0	8.377	26.09	0.694	1.35	53.91	1327
	11.5	8.339	16.397	3.719	1.366	60.91	1344
	23	8.316	19.111	2.738	1.377	59.45	1225.4
	34.5	8.339	15.225	4.314	1.393	58.91	1236.7