HRTEM and FTIR investigation of nanosized zinc ferrite irradiated with 100 MeV oxygen ions

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Present investigation reports the ion irradiation induced effects in nanosized zinc ferrite and investigated using high resolution transmission electron microscopy (HRTEM) and Fourier transform infrared (FTIR) spectroscopy. Zinc ferrite nanoparticles of different size were synthesized by sintering the precursor at the temperature varying from 400-1000°C by nitrate method. The samples were irradiated using 100 MeV oxygen ions at the fluence of $1 \times 10^{13}$ and $5 \times 10^{13}$ ions/cm$^2$ available from Pelletron Accelerator at IUAC, New Delhi. The electronic energy loss induced by these ions is 1.09 keV/nm, which is less than the threshold electronic energy loss value of ~ 13 keV/nm for creating columnar amorphization. Therefore, the formation of point and cluster of defects are expected to induce in these ferrite materials.

HRTEM investigation of these materials shows decrease in particle size after irradiation. FTIR study shows the high frequency bands $\nu_1$ (549-555 cm$^{-1}$) and $\nu_2$ (422-383 cm$^{-1}$) are attributed to the vibration of Fe$^{3+}$ ions in both tetrahedral, octahedral positions respectively. On the other hand the low frequency band $\nu_3$ (370-325 cm$^{-1}$) and $\nu_4$ (280-246 cm$^{-1}$) is attributed to the divalent octahedral metal ions and oxygen complexes and the lattice vibrational frequency respectively [1]. The presence of all the bands in pristine and irradiated ferrites evidenced zinc ferrite phase even after irradiation (Figure 1) in corroboration with x-ray diffraction and Raman spectroscopy study [2]. Presence of modes in the range 1000-2500 cm$^{-1}$ may be attributed to the presence of water in the samples, which may be due to absorbed moisture from atmosphere [3]. The change in width and intensity of modes is attributed to the irradiation induced cation migration and the detailed analysis of these investigations will be presented.

![Figure 1. FTIR spectra of the pristine and irradiated samples sintered at 400°C](image)