Physical characteristics and structural analysis of Gamma induced indium copper spinel ferrite nanocomposite using small angle scattering methods

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In this work, the structural and physical characteristics of $CuInFe_2O_3$ nanocomposite with concentration of indium constituent. This study focuses on elucidating the surface structure of the composite material at nano and macroscale, which are important for promising applications based on properties of spinel ferrites [1-7]. We also studied possible impact of gamma irradiation onto surface parameters, by emphasizing surface structure of composite's cluster using conventional morphological analysis along with small angle scattering methods. Nanocomposites samples were synthesized via the sol-gel method where Indium was incorporated into the matrix at varying concentrations. Post-synthesis, the samples were subjected to gamma irradiation at a dose of 600 kGy.

The magnetic properties were analysed by conducting hysteresis measurements using a Vibrating Sample Magnetometer (VSM) to evaluate the magnetic behaviour of the synthesized samples. Structural characterization techniques, including Small-Angle X-ray/neutron Scattering (SAXS/SANS), Transmission Electron Microscopy (TEM), and X-ray Diffraction (XRD), were employed to assess morphology and structural changes.

According to SAXS analysis, the nanocomposites have stable surfaces fractal structure with surface roughness of the order ($3.6 > P > 3.8$), even with different concentration of indium constituent no change in the structure form factor have been realized. From another hand studied nanocomposite show great stability against gamma impact without significant change in surface morphology. These findings have implications for optimizing the material properties for various applications where stable physical characteristics particularly surface structure of composite on the nanoscale represent big advantage for electrical, biomedical and for several applications.

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