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Temperature-dependent neutron diffraction and magnetic studies on magnesium ferrite (MgFe2O4) powder prepared via Sol-Gel auto-combustion method using DL-alanine fuel

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The present work investigates crystallographic and magnetic structures of post-annealed magnesium ferrite (MgFe2O4) powder using Neutron diffraction within a temperature range from 10 K to 300 K. The obtained crystallite and domain size variations show a robust correlation with the changes in magnetic properties, as determined by temperature-dependent magnetic measurements. Further, the study delves into the magnetic behavior under zero-field cooling (ZFC) and field-cooling (FC) conditions through the vibrating sample magnetometer (VSM), confirming the ferrimagnetic nature of MgFe2O4 powder. The decrease in Magnetic domain size with decreasing temperature and the negligible variation in crystallite size with a decrease in measurement temperature is thoroughly examined. This obtained decrease in domain size with decreasing temperature is attributed to the increase in the coercive field. Furthermore, the magnetic moments for one MgFe2O4 molecule have been estimated through the Rietveld refinement of neutron diffraction patterns, and the magnetic moment calculated from saturation magnetization shows good agreement. The Electron Spin Resonance (ESR) technique is employed to investigate the magnetic behavior of MgFe2O4 within a wide temperature range from 90 K to 300 K, focusing on dipolar and super-exchange interactions. The ESR spectra linewidth increases from 1225 Oe to 1870 Oe as the temperature decreases from 300 K to 90 K, indicating the enhancement of magnetic interactions.

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