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Effect of Yttrium Substitution on Structural Properties of nanopowder nickel ferrites: X-Ray and Raman studies

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Among various ferrites, nanosized nickel ferrite is one of the most frequently employed materials for production of electronic materials due to a set of outstanding physical and chemical properties. Doping with various atoms is a common choice when it comes to the development of new materials with target properties. Rare-earth elements have been frequently used in different research areas in order to improve various physical and chemical properties of materials. Nanocrystalline ferrites with chemical formula NiFe2−xYxO4 (x = 0.20, 0.30) have been synthesized by the co-precipitation method and further annealed at 750 ℃ . The details of the synthesis are given in [1]. X-Ray diffraction analysis (XRD) were carried out using Rigaky MiniFlex 600 diffractometer. Raman spectra were collected using a Thermo Scientific DXR Raman Microscope at room temperature with DPSS (Diode Pumped Solid State) laser using λ = 532.2 nm excitation. CCD camera has been used as detector.

Spinel ferrites crystallize in cubic spinel structure belonging to space group O7h (Fd3m). The recorded XRD patterns have confirmed the formation of spinel ferrite phase in the samples. No peaks corresponding to any precursor/impurity were recorded in the patterns implying that the samples are single phase. With the substitution of Y3+ in NFO, the whole diffraction pattern is shifted towards lower 2θ angle, which is a signature of an increase in lattice parameter of the substituted samples.

Group theory predicts the five Raman active modes, i.e. A1g + Eg + 3T2g. The measured spectra have been fitted and it is deconvoluted into individual Lorentzian component in order to determine the peak position. The spectra consists of band around ~ 450, ~ 560, ~ 640, ~ 680, ~ 695 cm-1. The modes at above 600 cm-1 are related to the T-site mode that reflects the local lattice strain effect in the tetrahedral sublattice. The Raman modes below than 600 cm-1 corresponds to the O-site mode reflecting the local lattice strain effect in octahedral sublattice.

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