Accepted Manuscript

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PII: S0925-8388(18)33162-1

DOI: 10.1016/j.jallcom.2018.08.273

Reference: JALCOM 47361

To appear in: *Journal of Alloys and Compounds*

Received Date: 25 March 2018

Revised Date: 27 July 2018

Accepted Date: 28 August 2018

Please cite this article as: S. Chihaoui, M. Koubaa, W. Cheikhrouhou-Koubaa, A. Cheikhrouhou, H. Guermazi, Effect of Ni doping on the structural, vibrational, optical and magnetic properties of $YMn_{0.4}Fe_{0.6-x}Ni_xO_3$ ($0 \leq x \leq 0.1$) nanoparticles, *Journal of Alloys and Compounds* (2018), doi: 10.1016/j.jallcom.2018.08.273.

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Abstract

Structural, vibrational, optical and magnetic properties of multiferroics $YMn_{0.4}Fe_{0.6-x}Ni_xO_3$ ($0 \leq x \leq 0.1$) nanoparticles, prepared by sol-gel method, have been investigated to study the effect of the substitution of Ni to Fe sites. The XRD patterns at room temperature, analyzed by Rietveld refinement method, confirm the existence of single phase in all compounds with orthorhombic structure belonging to Pnma space group. Fourier transform infrared spectroscopy (FTIR) analysis in the range of 400 – 800 cm^{-1}supports the XRD results. 10 Raman active modes ($6A_g$, $3B_{2g}$ and B_{3g}) have been observed for all samples in the range of 100–800 cm^{-1}. The changes in Raman modes frequency have been noticed with the increase of Ni concentration in $YMn_{0.4}Fe_{0.6-x}Ni_xO3$ nanoparticles. Ultraviolet–Visible spectroscopy has been utilized to characterize the nanoparticles. The Tauc model has been used to determine the optical gap energy of the synthesized nanoparticles. The optical band gap decreases from 3.32 to 2.71 eV with increasing Ni substitution. The magnetic characterization showed a spin reorientation transition which temperature of transition (T_{SR}) decreases with increasing Ni-concentration whereas the Néel temperature (T_N) increases. Moreover, the magnetic hysteresis curves at room temperature revealed a weak ferromagnetic (FM) behavior of all samples.

Keywords: Multiferroics, Sol-gel, XRD, FTIR, Raman, UV–Visible, Magnetic properties.

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