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A Structural and Magnetic Investigation of the Inversion Degree in Spinel NiFe2O4, ZnFe2O4 and Ni0.5Zn0.5Fe2O4 Ferrites Prepared by Soft Mechanochemical Synthesis

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Abstract : NiFe2O4 (nickel ferrite), ZnFe2O4 (zinc ferrite) and Ni0.5Zn0.5Fe2O4 (nickel-zinc ferrite) were prepared by mechanochemical route in a planetary ball mill starting from mixture of the appropriate quantities of the Ni(OH)2/Fe(OH)3, Zn(OH)2/Fe(OH)3 and Ni(OH)2/Zn(OH)2/Fe(OH)3 hydroxide powders. In order to monitor the progress of chemical reaction and confirm phase formation, powder samples obtained after 25 h, 18 h and 10 h of milling were characterized by X-ray diffraction (XRD), transmission electron microscopy (TEM), IR, Raman and Mössbauer spectroscopy. It is shown that the soft mechanochemical method, i.e. mechanochemical activation of hydroxides, produces high quality single phase ferrite samples in much more efficient way. From the IR spectroscopy of single phase samples it is obvious that energy of modes depends on the ratio of cations. It is obvious that all samples have more than 5 Raman active modes predicted by group theory in the normal spinel structure. Deconvolution of measured spectra allows one to conclude that all complex bands in the spectra are made of individual peaks with the intensities that vary from spectrum to spectrum. The deconvolution of Raman spectra allows to separate contributions of different cations to a particular type of vibration and to estimate the degree of inversion.

Keywords : ferrites, Raman spectroscopy, IR spectroscopy, Mössbauer measurements
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