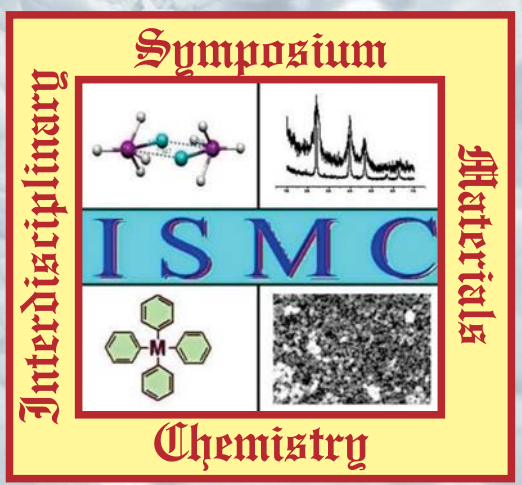
Proceedings of DAE - BRNS

8th Interdisciplinary Symposium on Materials Chemistry



June 17-19, 2021

Bhabha Atomic Research Centre
Mumbai, India

Chemistry Division
Bhabha Atomic Research Centre
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Society for Materials Chemistry, India

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Structural and Solid-State Properties of Mn Substituted Ni-Zn Ferrites Synthesized by Combustion Method

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Malic acid which is a dicarboxylic acid can act as an excellent fuel due to its low ignition temperature, high calorific value, non-explosive and low cost. To improvise the basic properties of Ni-Zn ferrites for example,to attain magnetic properties with low losses especially at high frequencies, etc., we decided to synthesizeMn substituted Ni-Zn ferrites using Malic acid as the fuel via combustion route.

A novel series of nano-sized $Zn_{0.5-x}Mn_xNi_{0.5}Fe_2O_4$ (x= 0.1-0.3) were prepared using metal nitrates and Malic acid as fuel in the ratio of 1:0.97 by combustion technique after optimization.

XRD studies confirmed the formation of single-phase cubic spinel ferrites [1]. The crystallite size ranged between 10-23 nm. The IR spectra showed the presence of two M-O stretching vibrations in the frequency range of 800-350 cm^{-1} which are the characteristic bands of spinel ferrites. EDX spectra confirmed the presence of desired elements and SEM image showed spherical particles with agglomeration.A decrease in resistivity was observed with rise in temperature indicating the semiconducting behaviour of spinel ferrites [2]. Also fall in resistivity was seen with increase in Mn content. Curie temperature was seen increasing with increase in Mn concentration. Normal behaviour of spinel ferrites was observed in dielectric studies where a sharp decrease in dielectric constant at lower frequencies was observed which remains constant with further increase in frequency [3]. Relaxation peaks for all the synthesized ferrites were observed which occur when the hopping frequency is equal to the externally applied frequency [4].

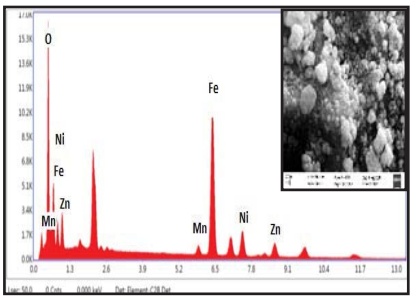

Figure 1. SEM/EDX images of $Zn_{0.4}Mn_{0.1}Ni_{0.5}Fe_2O_4$

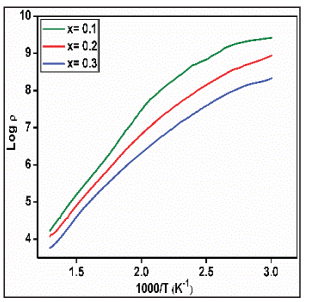

Figure 2. Plot of logρ v/s 1000/T

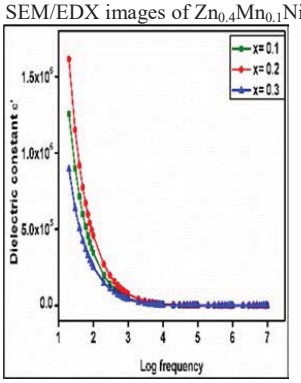

Figure 3. Plot of dielectric constant v/s frequency

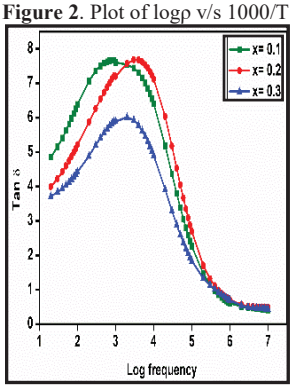

Figure 4. Plot of tan δ v/s frequency

Table 1: Crystallite size (D),M-O_{tetra} (υ_1) and M-O_{oct}(υ_2)stretching vibrations in IR spectra and Curie temperature (Tc)

X	D nm	υ_1 (cm^{-1})	υ_2 (cm^{-1})	Tc (K)
0.1	22.81	592	409	633
0.2	18.47	597	408	678
0.3	10.35	598	408	708

A novel series of $Zn_{0.5-x}Mn_xNi_{0.5}Fe_2O_4$ (x= 0.1-0.3) spinel nano-ferrites were synthesized by combustion method. The 'as prepared' ferrites were characterized by XRD, IR, SEM/EDX and AC susceptibility. Electrical resistivity measurements confirmed the semiconducting nature of Mn substituted Ni-Zn ferrites. Dielectric properties were studied as a function of frequency which showed a normal behaviour of spinel ferrites.

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