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Structural and Magnetic Properties of Li-Cr-Zn Ferrites

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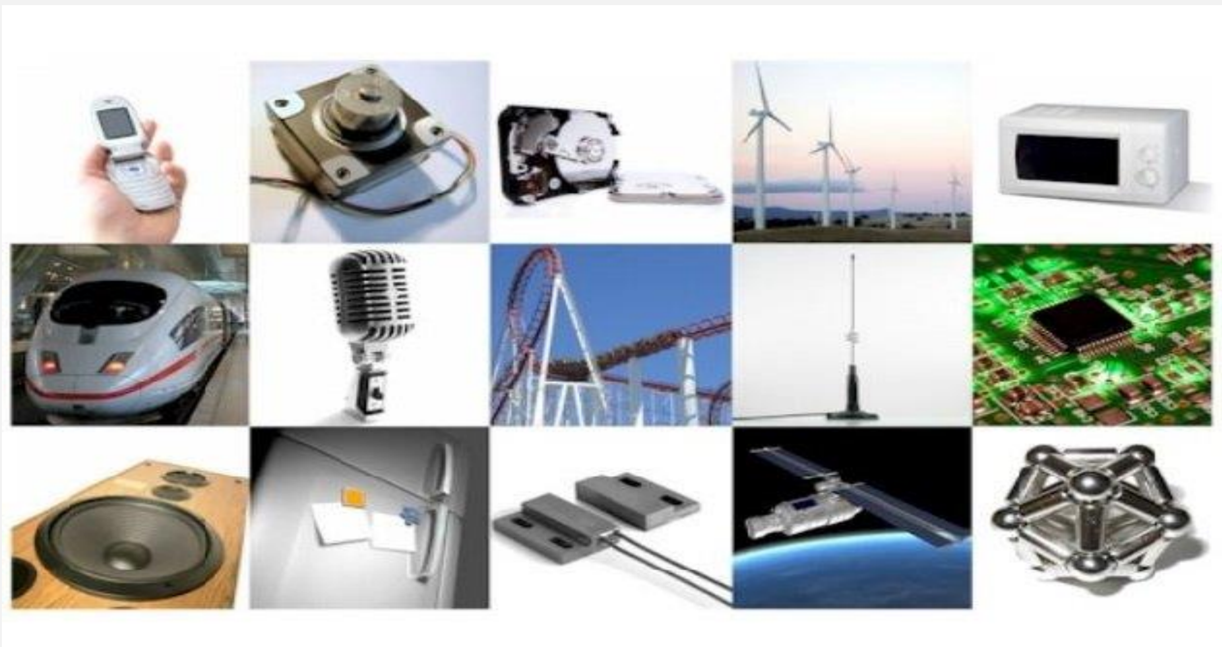
Abstract

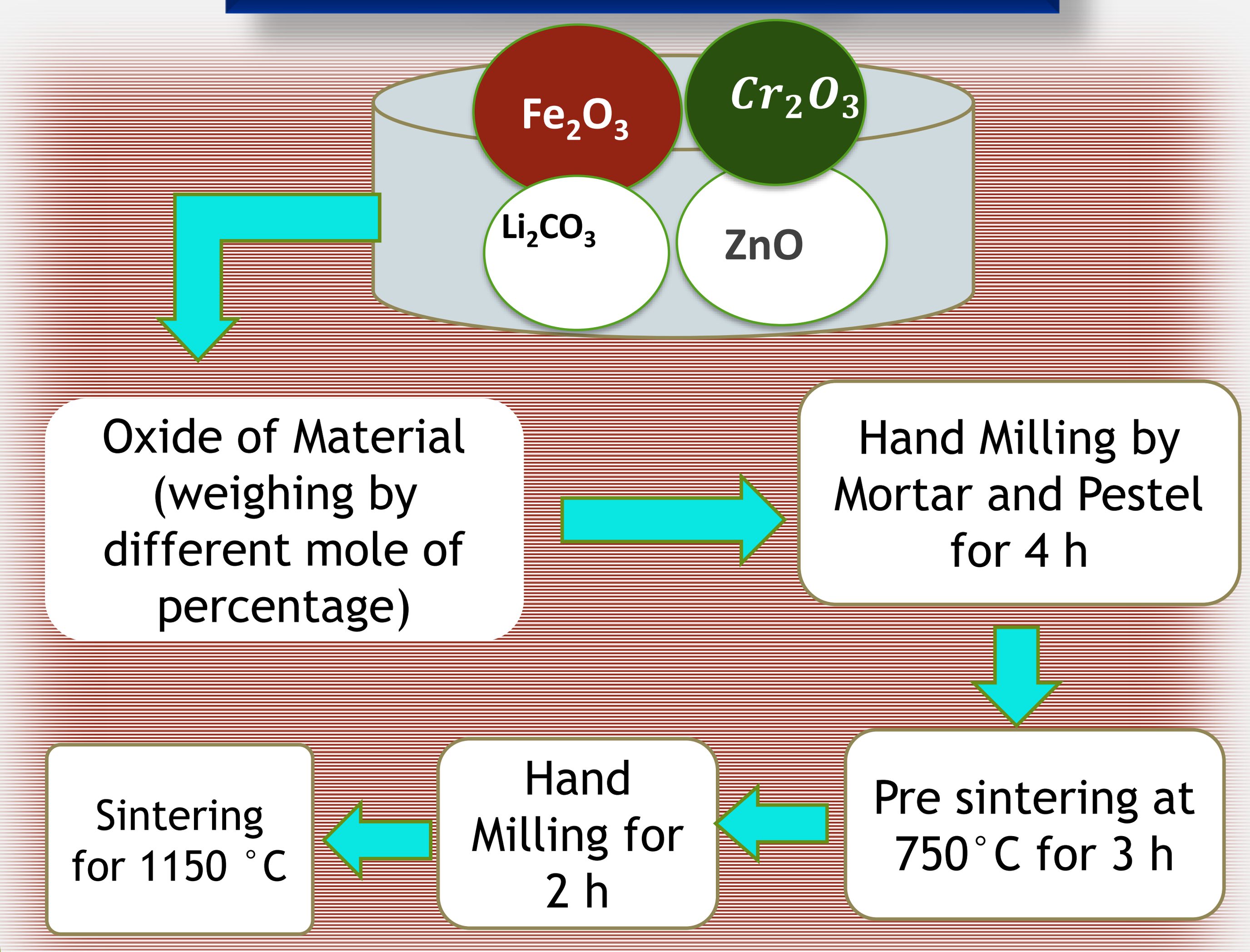
The effects of Cr^{3+} substitution on the structural and magnetic properties of Li-Zn ferrites are observed in this study. The single phase cubic spinel structure is found by studying crystal structure by XRD. From the M-H curve it was found that the saturation magnetization decreases with the increase of Cr contents. Frequency dependent magnetic permeability of the prepared samples was investigated to obtain the initial magnetic permeability and relative quality factor (RQF) using an impedance analyzer. The resonant frequency shifts toward the higher frequency with Cr contents, which is expected according to Snoek's relation. Dielectric constant, ac conductivity and resistivity were investigated as a function of frequency at room temperature. The complex impedance spectroscopy through Cole-Cole plot showed that the conduction process is dominated by both the effect of grain and grain boundary of the samples.

Introduction

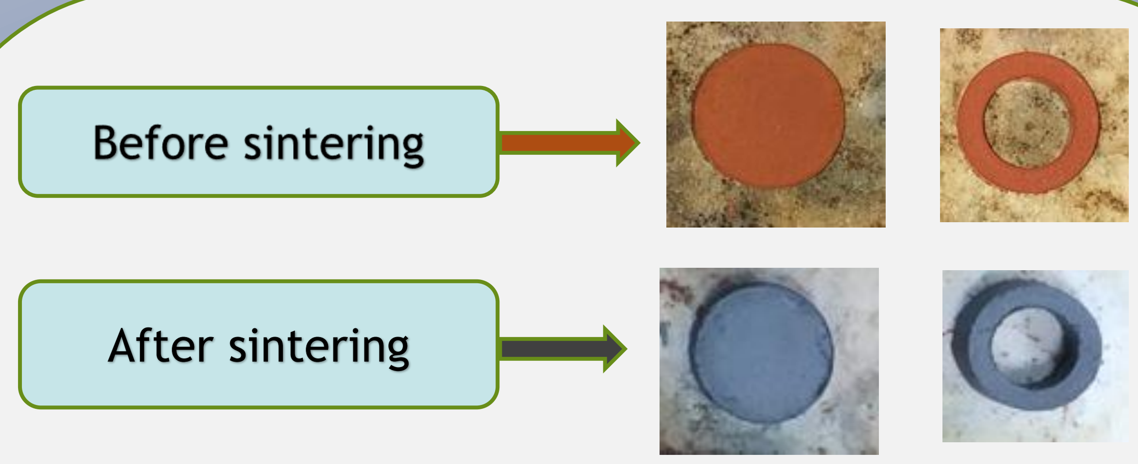
Lithium ferrites and substituted lithium ferrites have become important materials for the microwave and high frequency applications such as in circulators, inductors isolators , antennas and phase shifters due to their high resistivity, low dielectric losses, high Curie temperature, square hysteresis loop, and low cost.



Methodology



Flow chart of sample preparation



Result

X-ray Diffraction

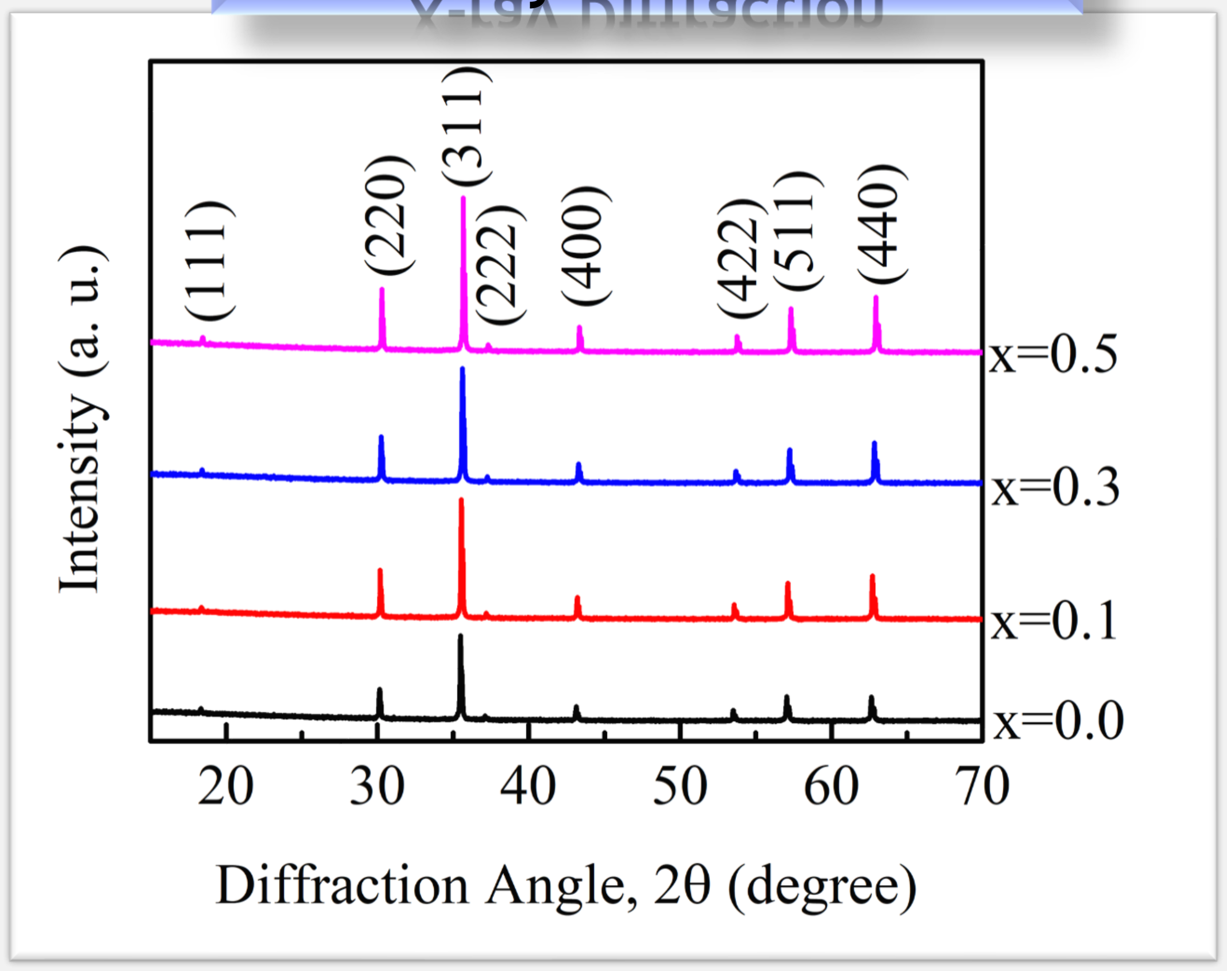


Fig 1 X-Ray Diffraction for $Li_{0.3}Zn_{0.4}Cr_xFe_{2.3-x}O_4$

Table 1:data on lattice parameter, crystallite size ,X-Ray density ,Bulk density ,porosity of $\mathbf{Li_{0.3}Zn_{0.4}Cr_xFe_{2.3-x}O_4}$

Composition (X)	Lattice Parameter (Å)	Crystallite size (nm)	Bulk density (g/Cm³)	X-ray density (g/Cm³)	Porosity
0.0	8.385	114	4.384	5.123	14.4
0.1	8.375	136	4.420	5.132	13.87
0.3	8.360	124	4.302	5.143	16.35
0.5	8.349	158	4.457	5.146	13.39

Magnetic- hysteresis loop

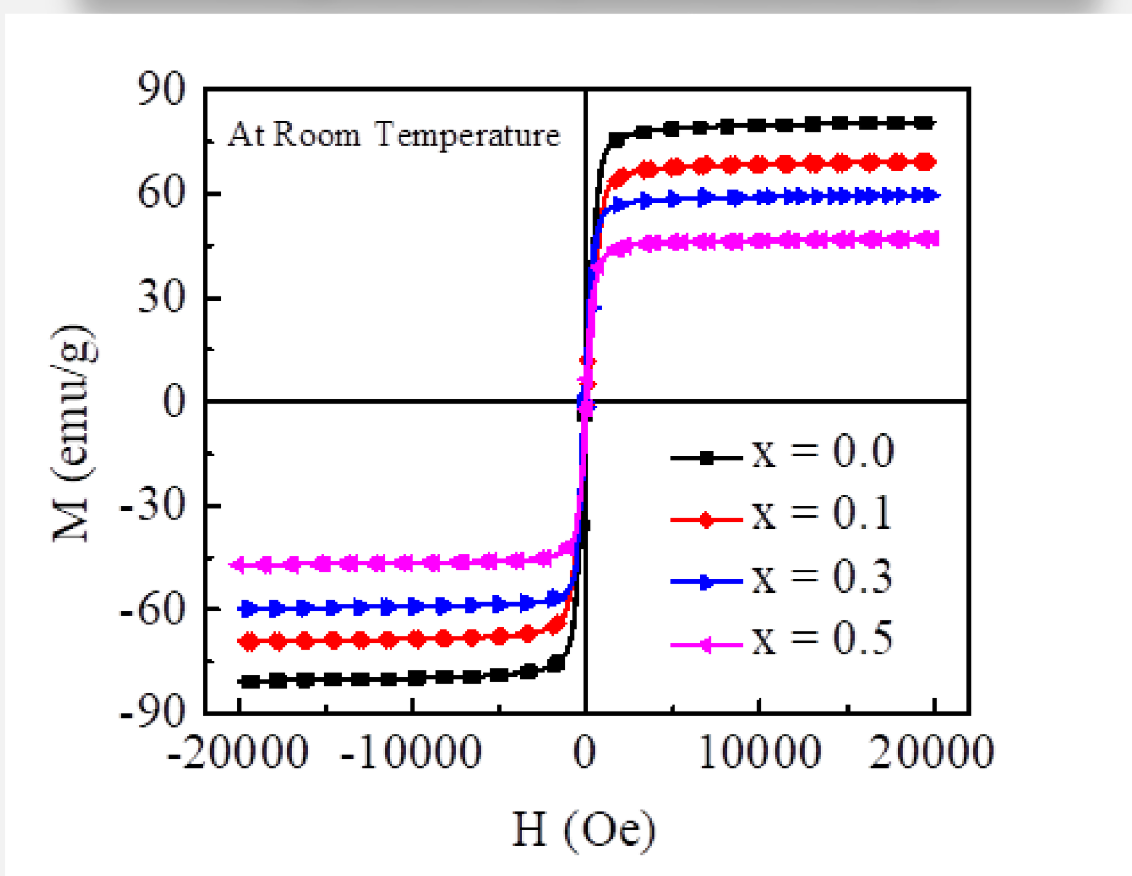
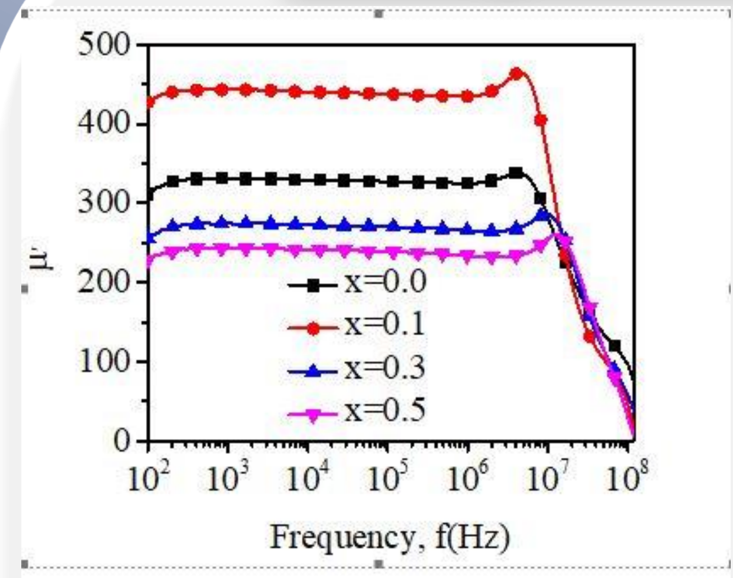
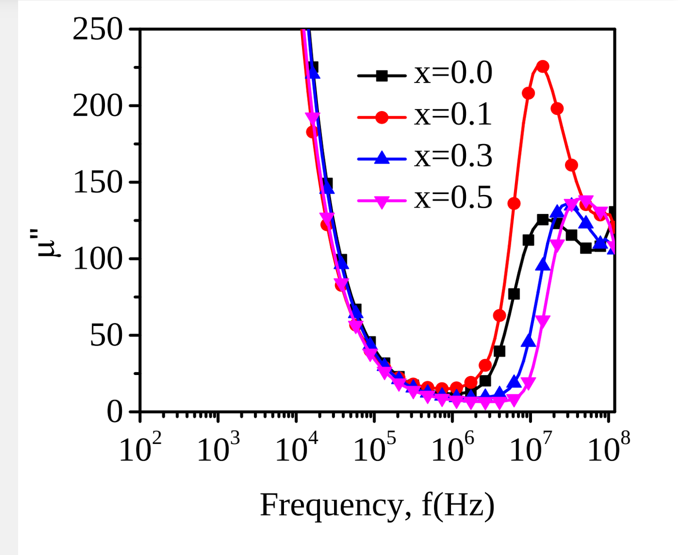


Fig 2:magnetization vs magnetic field graph of $Li_{0.3}Zn_{0.4}Cr_xFe_{2.3-x}O_4$

Magnetic Permeability





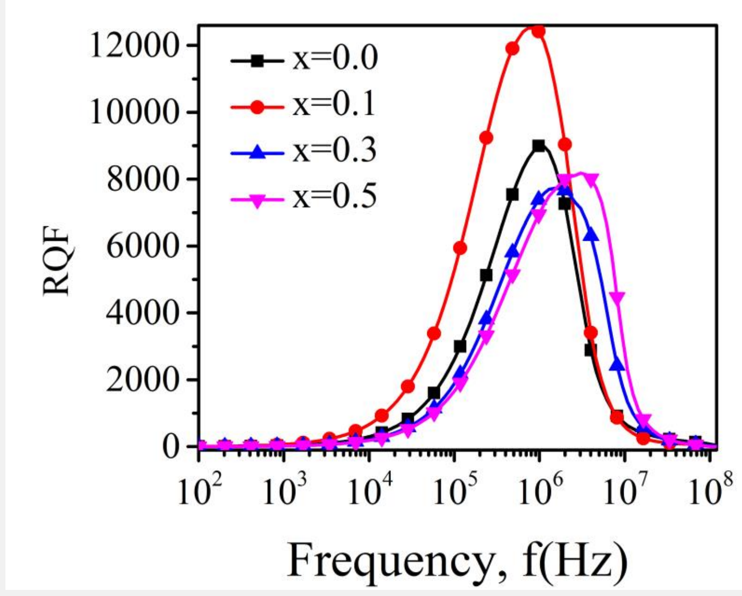
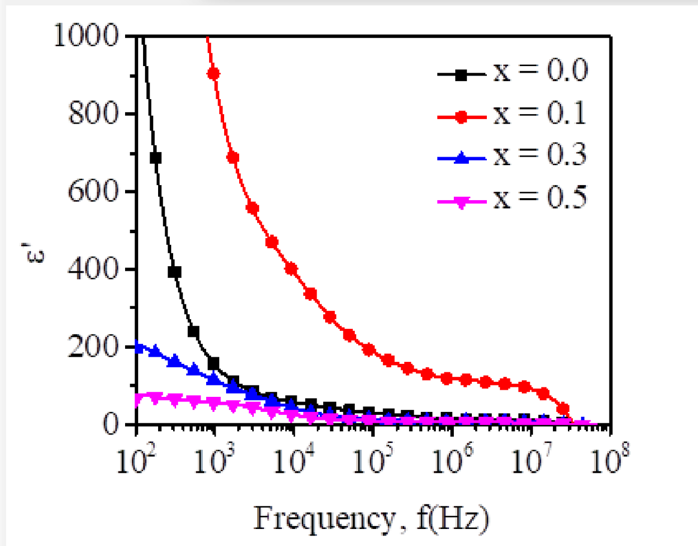
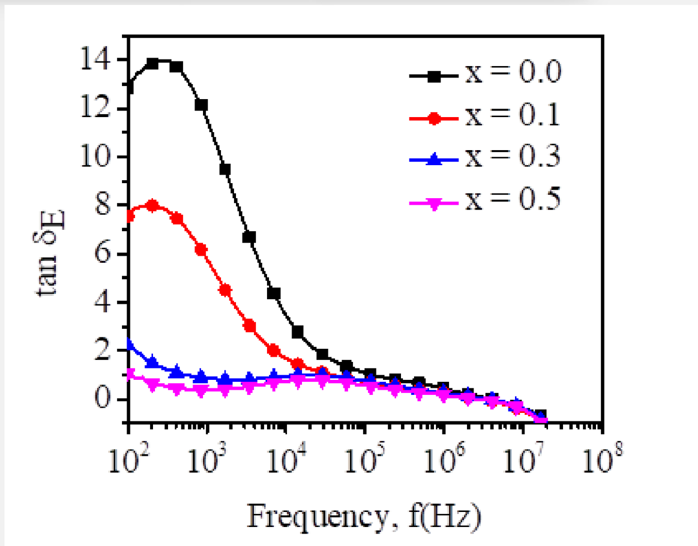


Fig 3: real part and imaginary part of initial permeability vs frequency and RQF vs frequency graph.

Dielectric Property





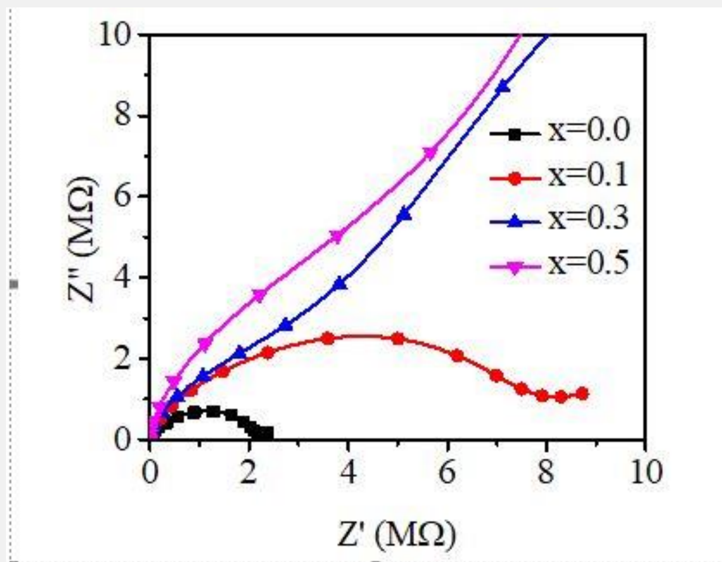


Fig 4: dielectric constant and dielectric loss vs frequency and cole cole plot .

Conclusion

Cr substitution can tailor the micro-structural and electromagnetic properties of Li-Zn ferrites along with plausible optimization of magnetic loss components. the eddy current loss of Li-Zn can modify the electrical transport properties. In addition, Cr substituted Li-Zn ferrite scan improve the frequency stability nature in the complex magnetic permeability profile. These findings may be helpful in low loss electromagnetic devices.

Acknolagement

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