EFFECT OF RARE EARTH (Sm^{3+}, La^{3+}AND Y^{3+}) SUBSTITUTION ON ELECTRICAL AND MAGNETIC PROPERTIES OF Ni-Zn FERRITES

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SUMMARY

Recently, soft magnetic Ni-Zn ferrite with high resistivity and high complex permeability have critical need for high frequency applications such as RF (radio frequency) broadband choke coils, the electromagnetic (EM) noise, and electromagnetic interference (EMI) suppressors. The properties of these ferrites are dependent on many factors such as temperature, composition, cation distribution and method of preparation.

Generally ferrites were prepared by conventional ceramic method. This method requires high sintering temperature, which may cause evaporation of zinc in nickel-zinc ferrites and results the desired stiochiometry and also affects the electrical as well as magnetic properties. In order to overcome these drawbacks, the chemical methods like co-precipitation, sol-gel method, hydrothermal decomposition, citrate precursor method, reverse micelle technique, hydrothermal method, nitrate-citrate precursor method, refluxing method, auto combustion method etc. have been developed to synthesize nanosized nickel-zinc ferrites. Among these methods, the co-precipitation technique is a useful and attractive technique for the preparation of nanosized particles because of its advantages like good stoichiometric control and the production of ultrafine particles with low sintering temperature and smaller duration.

In present work, ferrites samples with chemical formula $Ni_{0.6}Zn_{0.4}R_xFe_{2-x}O_4$, (R = La^{3+}, Sm^{3+} and Y^{3+}; x = 0.01, 0.02 and 0.03) were prepared by oxalate co-precipitation method. The ferrite samples under investigation were characterized by XRD, IR and SEM techniques.

X-ray diffraction study shows the formation of cubic spinal structure of all the samples. It is observed that, the crystallite size of the samples lies in the range 33.32 to 35.57 nm and changes randomly with increase in rare earth content.

The IR spectra show two major absorption bands in the frequency range 400 cm^{-1} to 600 cm^{-1} along with additional band in the range 470.5 cm^{-1} to 493.2 cm^{-1} confirms the well formation of ferrites.

It is observed that, the average grain size of the ferrites found to lies in the range 0.201to 0.270 μm. The grain size of the samples decreases with increase in rare earth contents.

It is observed that the resistivity of the Ni-Zn ferrites increases with increase in rare earth contents. This is attributed to decrease in grain size with increase in rare earth content. The dielectric measurements were carried out on LCR meter bridge (HP 4284 A) in the frequency range of 20 Hz to 5 MHz at room temperature. It is seen that dielectric constant decreases with increase in frequency; and is a normal dielectric behavior of soft ferrites.

It is observed that the saturation magnetization of the Ni-Zn ferrites decreases with increase in La^{3+} content. The Curie temperature obtained by Loria-Sinha technique shows good agreement with that observed in DC resistivity measurements. It is observed that the Curie temperature of Ni-Zn ferrites decreases with increasing rare earth content.

LIST OF PUBLICATIONS

Sr. No. | Papers published in International Journals & Conferences

1. T. J. Shinde, A. B. Gadkari and P. N. Vasambekar, "Preparation and characterization of La^{3+} substituted Ni-Zn ferrites, Proc. of International Conference on Advanced and Applied InterICAAMS- 2014; Pages 27- 31
2. T. J. Shinde, A. B. Gadkari, Surender Kumar, P. N. Vasambekar, "Synthesis and Structural Properties of Samarium Substituted Nanocrystalline Ni-Zn Ferrites"- paper presented in the 8th International Conference on Materials for Advanced Technologies of the Materials Research Society of Singapore & 16th IUMRS- International Conference in Asia (**ICMAT 2015 & IUMRS-ICA2015)** Singapore held during the period 28 June to 3 July 2015.
3. T. J. Shinde, A. B. Gadkari and P. N. Vasambekar, "**Dc Electrical Resistivity of Samarium Substituted Nanocrystalline Nickel- Zinc Ferrites"** presented in the 8th International Conference on Materials for Advanced Technologies of the Materials Research Society of Singapore & 16th IUMRS- International Conference in Asia (**ICMAT 2015 & IUMRS-ICA2015)** Singapore held during the period 28 June to 3 July 2015.

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ICMAT15-A-0694: Synthesis and Structural Properties of Samarium Substituted Nanocrystalline Ni-Zn Ferrites

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ICMAT15-A-3219: Dc Electrical Resistivity of Samarium Substituted Nanocrystalline Nickel- Zinc Ferrites

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