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STRUCTURAL, OPTICAL AND DIELECTRIC PROPERTIES OF TRANSITION METAL

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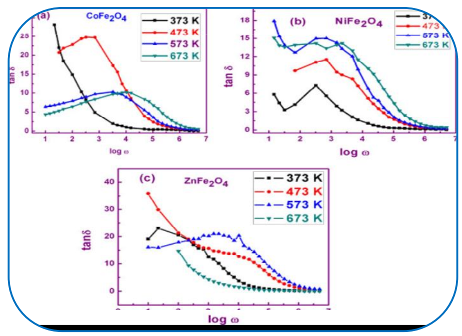
ABSTRACT:



In the present paper, the transition metal spinel ferrite (MFe_2O_4; M = Co, Ni, ZN) nanostructures have been chemically assembled by co-precipitation method. XRD analysis confirms the formation of a cubic spinel-type structure with the space group FD3M and the average crystallite size measured by Shearer's formula in the range 9–15 to 14 nm. Electron microscopy scanning was used to study the surface morphology of the samples. Furthermore, Raman and PL spectra also confirm the formation of cubic structures. Raman spectra measured on cobalt, nickel and zinc ferrite revealed more phonon bands than expected in cubic spinal structures. The optical energy band distances obtained from the ultraviolet-vis absorption spectra as coefficients were found to be 2.44, 4.4 and 3.2e eV for $CoFe_2O$, $NIFe_2O_4$ and $ZnFe_2O$, respectively. Analysis of the complex impedance spectra of all ferrite samples shows the presence of a semi-circular arc at all selected temperatures, which shows the main role of the grain boundary contribution. Dielectric constants were measured at different temperatures in the frequency range from 10 Hz to 5 MHz and showed a sudden decrease with increasing frequency and maintained steady state or stability for all three samples. The AC conductivity has been increased in the frequency and temperature of all the three specimens explained on the basis of the constitutional theory of angle.

KEYWORDS: *Electron microscopy , cubic structures.*

INTRODUCTION :-

At present, the synthesis of nanomaterial is of great interest due to their uniqueness and remarkable properties and has become an active field of research in physics, chemistry, medical science and literature engineering as well as multi-disciplinary research. Engineered materials at Nano cell have the advantage of their small size and novelty properties that are not commonly seen in their traditional, bulk parts. The main reasons why materials in nanoscols may have different properties are the increase in the surface area and proportions of the respective surfaces. Furthermore, quantum effects in Nano cells may become more important and dominant in determining physical properties and characteristics that lead to novel optical, electrical, magnetic, and ferroelectric properties. These interesting properties allow the use of Nano-structured materials in Nano applications in science and technology.

In recent years, researchers and scientists have shown great interest in transition metal nanopheritis due to the chemical and physical properties required for many categories of science and technology. Ferrites are significant materials, both from a perspective as well as from a basic research perspective. Transition metal spinel ferrite is a class of ferromagnetic ceramic compounds in which the general molecular formula of ion distribution A3 + [B2 + B3 +] O4 2 is MFe_2O_4 (where M = Zn, Ni, Co, etc.). Where A indicates the tetrahedral cation site and B indicates the extraetral cation site.

The tetrahedral A-sites occupy half of the FE + cations, while the octahedral bee mesh replaces the remaining F3 + cations and divine M2 + cations. The unit cell of spinel ferrites is composed of 32 oxygen atoms in a cubic closed-packed system distributed between the tetrahedral ("A") and the octahedral sites ("B"). Transition metal spinel ferrite (MFe_2O_4; M = Co, Ni, ZN) are familiar with their remarkable optical, electrical, and dielectric properties in nanocells. Doping with selected components suggests an effective method for enhancing and controlling the structural, optical, electrical and dielectric properties of nanostructures. Therefore, doping with transition metal ions as (Ko, Ni and ZN) is intended to improve the physiochemical properties of ferrite nanoparticles. Among the various ferrites, $CoFe_2O$ (CFO), $NiFe_2O$ (NFO) and $ZnFe_2O$ (ZFO) have been noted for their chemical and thermal stability and exceptional structural, optical, magnetic, electrical and dielectric properties is pierced.

The methods of preparation of chemical nanopherites of transition metal nanopherites are very sensitive to the conditions of synthesis as well. Therefore, the selection of the right method plays an important role in the tailoring of properties and in obtaining high quality nanopherites. For this reason many physical and chemical methods have been used for the synthesis of nanopheritis such as Nono-precipitation method, sol gel, hydrothermal, auto-combustion method, ball-milling (HBBM), refluxing method, solvothermal method, sonochemical method etc…

Experimental:

1. **Chemical:** For making transition metal ferrite nanoparticles, the leading material used was iron nitrate nonhydrate, (Fe(NO3)3 · 9H2O, 99.0%, Loba Kemi, Mumbai, India), cobalt nitrate hexahydrate co (NO3)2H2O, nickel was nitrate hexhydrate Ni (NO3) 2 6H2O and zinc nitrate hexhydrate ZN (NO3) 2 6H2O (98.6%), sodium hydroxide (NOH, 98.1%), absolute ethanol (CH) 3CH2OH, 99.9%, Changshu Yangyuan Chemical, China) -Inised Water (Jayaravik, New Delhi, India) The chemicals used in the present work were of analytical grade and are used without further purification.
2. **Synthesis:** Various aspects of teleportation have been experimentally demonstrated. For example, Xiao Zhao et al demonstrated the teleportation of massive particles (molecules), MD Barretti et al., by creating a five-quit complex state of photons. Quit using limited (BB) ions in ion traps and Eun-feng Huang, etc. performed experimental teleportation of CNOT gates. The solution was then brought to a temperature of 90^0C. The solution was stirred for 60 minutes and then cooled to room temperature. The solution was washed three times with distilled water and finally with ethanol to remove impurities and excess surfactants. Non-synthesized nanoparticles were concentrated at30 min 3750 rpm and dried overnight at 100^0C. The dried particles were milled in an agate mortar. For characterization the powdered nanoparticles were diluted at 600^0C for 4 h.
3. **Characterization:** The obtained powder was shown by X-ray diffractometer with Q-K radiation source (λ = 1.6218 with) for structural and phase purity analysis. XRD data were collected in the range of 2θ from 15^0 to 75^0 with the amount of 2 counting per minute. Morphology and structural characterization were performed by scanning the electron microscope (SEM). To investigate the optical properties of synthetic ferrite nanostructures, photoluminescence (PL) spectra, Raman spectra, and ultraviolet visible spectra were measured at room temperature. Measurements of IV were measured on silver coated pellets using a two-probe setup (Kithly) and a DC resistivity (ρ). Complex impedance analysis was performed on silver-coated pellets with a diameter of 10 mm using pontianostat / galvanostat in the frequency range of 10 Hz to 5 MHz at different selected temperatures.

RESULT AND DISCUSSION:

1. **Diffraction of X-Ray:** X-ray diffraction (XRD) is studied to study the synthetic crystallographic properties of infected metal ferrite nanostructures. The XRD study gives complete information about crystal structure, orientation and average crystalline size XRD samples of MFE2O4 (M = Co, Ni, ZN) nanostructures were collected by co-precipitation method. The corresponding XRD peaks can be indexed, and the aircraft confirming the formation of a single-phase cubic spinal structure with an FD_3 m space group are consistent with the JCPDS data, as well as the data in the previous report. Peaks labelled by Fe_2O_3 can be indexed. Furthermore, extending the line of XRD peaks as observed shows the nanocrystalline form of the synthesized samples. The resulting values of crystallite size obtained from the strongest reflections are 14, 9, and 12 nm for $CoFe_2O_4$, $NiFe_2O_4$, and $ZnFe_2O_4$, respectively. Reducing the crystallite size increases the surface volume ratio. An increase in the volume ratio at the surface is a good signal for physical air sensing applications.

CONCLUSION:

In summary, the transition metal nanopheritis $CoFe_2O_4$, $Nife_2O_4$ & and $ZnFe_2O_4$ were successfully combined by co-precipitation method. Differences in structural, optical, electrical and dielectric properties are observed for $CoFe_2O_4$, $NiFe_2O_4$ and $ZnFe_2O_4$ ferrite nanostructures. XRD analysis confirms the formation of a single-phase cubic spinal structure with space group Fd3m for all synthesized specimens. SEM images reveal particles in the nanosize range. Furthermore, Raman and photomoluminescence spectra also confirm the phase formation of transition metal nanopheritis. Raman spectra measured on cobalt, nickel and zinc ferrite revealed more phonon bands than expected in cubic spinal structures.

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