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Synthesis, Characterization, and Dielectric Study of Titania Supported $ZnFe_2O_4$

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The nanocomposites of TiO_2 loaded $ZnFe_2O_4$powders are synthesized using wet chemical process. The synthesized powder is characterized by using XRD, TEM, and VSM. In the XRD patterns of sintered composite samples, no peaks other than TiO_2 and $ZnFe_2O_4$ are observed. Nanosized two different layers such as cubic zinc ferrite and $TiO_2$are confirmed by transmission electron microscopy technique. The dielectric properties are measured in the frequency range of 20 Hz–1 MHz. The frequency variation of dielectric properties is understood with the help of Maxwell–Wagner type of interfacial polarization, which is in agreement with Koop's phenomenological theory. Dielectric permittivity data reveals dielectric permittivity decreases with frequency and increases with TiO_2 composition. The dielectric constant (ϵ') is decreased continuously with increased frequency for all the samples at room temperature revealing normal dielectric behavior of ferrites. Magnetic properties are also measured on all the composite samples at room temperature. The saturation magnetization (Ms) of the samples decreases with an increase of TiO_2content in $ZnFe_2O_4$.

1. Introduction

Now a days, nanoscaled mixed-metal oxides are attracting more interest in the scientific community because of its functional applications in high density data storage,[1] catalysis,[2] magnetically guided drug delivery,[3] ferro-fluids,[4] and magnetic-refrigeration systems.[5]Mixed-metal oxides having general formula AB_2O_4, where A is the divalent metal ion, B the trivalent metal ion, and O^{2-} is the oxide ion. Metal and substituted metal ferrites are useful for microwave devices such as isolators, circulars, gyrators, phase shifters, cathode materials, and memory cores owing to their high Curie temperature, high resistivity, low eddy current losses, high saturation magnetization (Ms), and hysteresis loop properties, which offer better performance advantage over other spinel structures. In these mixed-metal oxides iron is main element, therefore these materials are called as ferrites. In our earlier research work, we have synthesized various mixed-metal oxides or ferrites such as $ZnFeMnO_4$,$ZnTiFeO_4$, and $LiMn_{2.5}O_4$.[6–8]The structural, magnetic, and electrical properties of theses ferrites were based on method of preparation, sintering temperature, atmospheric conditions, complexing agent, and purity of metal salts.

Several researchers have prepared different nanosized ferrites by physical and chemical methods such as such as microwave refluxing,[9] sol—gel,[10]hydrothermal,[11,12] co-precipitation,[13] citrate-gel,[14] and spray pyrolysis,[15] etc. Out of all methods, our interest only in citrate-gel method because this method is superior than others, not require any sophisticated instrument, obtained homogenous uniform grains, and require low sintering temperature.

In this article, we have synthesized 10%, 20%, and 30% TiO_2supported zinc ferrite by citrate-gel and impregnation method. After synthesis, structural properties of all samples were characterized by XRD and TEM analysis. Magnetic study was carried out by using vibrating sample magnetometer (VSM). This research work was already published in one reputed journal[2] but dielectric permittivity study for 10%, 20%, and 30% TiO_2 supported zinc ferrites nanocomposite samples are not available in literature. Therefore, our interest was synthesizing such type of nanocomposites and study their structural, magnetic, and dielectric properties are investigated in this study.

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