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# Sucrose-Assisted Combustion Synthesis and Characterization of Zn-Substituted $NiFe_2O_4$ Nanocrystals

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**$Ni_{1-x}Zn_xFe_2O_4$ nanoparticles ($x$ = 0.0–1.0) were successfully prepared via sucrose-assisted autocombustion method. Thermal analysis measurements indicated that the ferrite nanoparticles could be synthesized in this self-propagating combustion process. The microstructure and magnetic properties were investigated by means of X-ray diffraction, transmission electron microscope, Fourier transform infrared, and vibrating sample magnetometer. The crystallite sizes obtained using Scherrer's equation are in the range 25–35 nm. An appropriate cation distribution was suggested based on the structural and magnetic measurements. The increase in the saturation magnetization with increasing Zn-content up to $x$ = 0.4 and its subsequent decrease was discussed in the view of entire cation distribution. The decrease in the coercivity with increasing Zn content was attributed to the change in the magnetocrystalline anisotropy.**

***Index Terms*—Cation distribution, magnetic materials, nanoparticles, Ni–Zn ferrites, sucrose.**

## I. Introduction

Ni–Zn ferrites are gaining to increase attention in both the electrical and magnetic properties due to their high resistivity, low dielectric losses, mechanical hardness, and high Curie temperature [1]. The properties of these ferrites can be controlled by varying the processing procedures, sintering conditions, or their chemical composition.

In this paper, a wet chemical method known as sucroseassisted combustion method, which has proven to be an appropriate method for the preparation of nanocrystalline materials [2], [3], was used. In this technique, metal nitrates acting as an oxidant are mixed with sucrose, which acts as a reductant. The method is actually self-sustainable after the exothermic reaction has initiated, which generate high temperatures ensure the crystallization and formation of ferrites in a short time.

Many researchers have been investigated the different characteristics of Ni–Zn ferrites, such as structural, electrical, and magnetic properties [4]–[8]. However, there is no study correlating the chemical composition with the structural and magnetic properties of Ni–Zn ferrites prepared through the present combustion synthesis.

In this paper, $Ni_{1-x}Zn_xFe_2O_4$ nanocrystalline ferrites ($x$ = 0.0–1.0) will be prepared via simple, economic, and environmentally friend sucrose-assisted autocombustion method. The effect of Zn-content on the structural and magnetic properties of the entire system will be investigated and discussed using the X-ray diffraction (XRD), Fourier transform infrared (FT-IR), transmission electron microscope (TEM), and vibrating sample magnetometer (VSM) techniques. Accordingly, an appropriate cation distribution of the entire system will be suggested.

## II. Experiment

$Ni_{1-x}Zn_xFe_2O_4$ ($x$ = 0.0–1.0) ferrites were prepared using the sucrose-assisted combustion method. Sucrose solution

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