Synthesis and characterization of nanocrystalline Zinc ferrite

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Abstract

$ZnFe_2O_4$ was synthesized by using sol-gel method under stoichiometric conditions. The structure and the crystal phase of the powder were characterized on an X-ray diffractometer. The ferrite powder existed as single phase cubic spinel oxide and has a particle size of ~30nm.

Keywords: Zinc ferrite, XRD, SEM.

1. Introduction

Zinc ferrite has found use in electromagnetic applications that requires a high permeability, such as inductors and electromagnetic wave absorber [1]. Several workers have studied these ferrites both on basic properties and on the influence of various substitutions depending on the application of interest [2-4]. Spinel ferrite is commercially important materials because of their excellent magnetic and electrical properties [5-8]. The usefulness of ferrites is influenced by the physical and chemical properties of the materials and depends on many factors including the method of preperation. Magnetic properties of spinel ferrites can be discussed on the basis of magnetic parameters such as saturation magnetization, magnetic moment, retaintivity, coercivity, magnetic loss, susceptibility, permeability etc. The choice of ferrite for an application is based on its magnetic properties. Ferrites possess large spontaneous magnetization due to their antiparallel arrangement of spin magnetic moments having unequal magnitudes. The oxygen ions present between two metal ions in ferrites drastically change all the properties of ferrites to make them most versatile materials for device applications.

2. Experimental

Polycrystalline sample $ZnFe_2O_4$ was synthesized by sol-gel method. The zinc nitrate, Iron nitrate and Citric acid were mixed in the required stoichiometric ratios in distilled water. The pH of the solution was maintained between 9 and 9.5 using ammonia solution. The solution was transformed to dry gel on heating to 353K. On further heating the dried gel burnt in a self

propagating combustion manner until all the gel completely converted to a floppy loose powder. This precursor powder was sintered at 973 K for 8 h. The sintered powders were granulated using 2 % polyvinyl alcohol as a binder and were uniaxially pressed at a pressure of 8 ton /cm^2 to form pellets. These pellets were gradually heated to about 773K to remove out the binder material.

X-ray powders diffraction patterns were recorded on a diffractometer (Philips PW 1730) with microprocessor controller, using CrKα radiation (λ = 2.289Å). Scanning electron microscopic studies (JEOL JSM 6360) was carried out for evaluation of surface topography.

3. Result and discussions

3.1. XRD Study

The X-ray diffraction patterns of $ZnFe_2O_4$ was indicate that a single phase cubic spinel structure (**Fig.1).** Further, the particle size was estimated using line broadening analysis of X-ray diffraction and it found particle size ~30 nm.

3.2. SEM Analysis

Scanning electron micrograph of the sample is shown in **Fig.2** and it indicates the formation of grains by aggregation of small crystallites. The average grain size was calculated by Cottrell's method and it lies in the range 0.5-1µm.

4. Conclusion

Zinc ferrite was synthesized by sol-gel method. The samples shows single phase cubic in nature. The ferrospinels synthesized by autocombusion method were in homogenous and uniform grain size.

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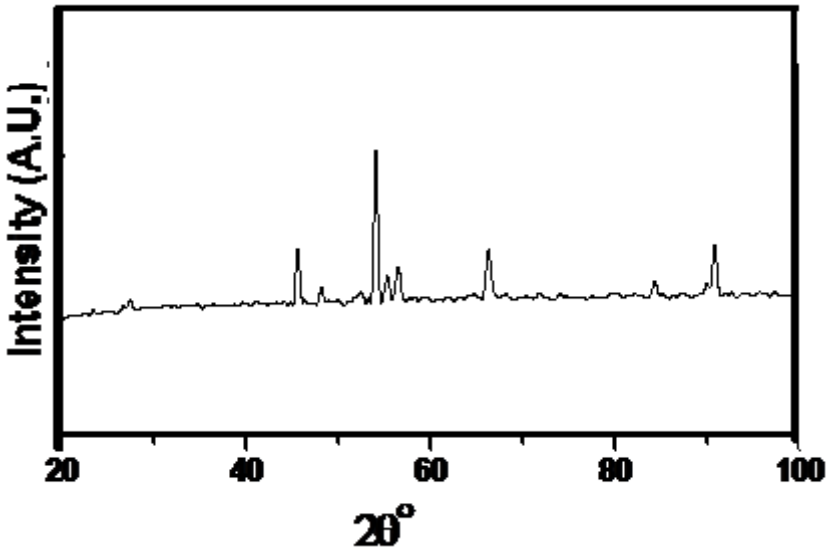

Fig. 1 X-ray diffraction pattern of $ZnFe_2O_4$ system

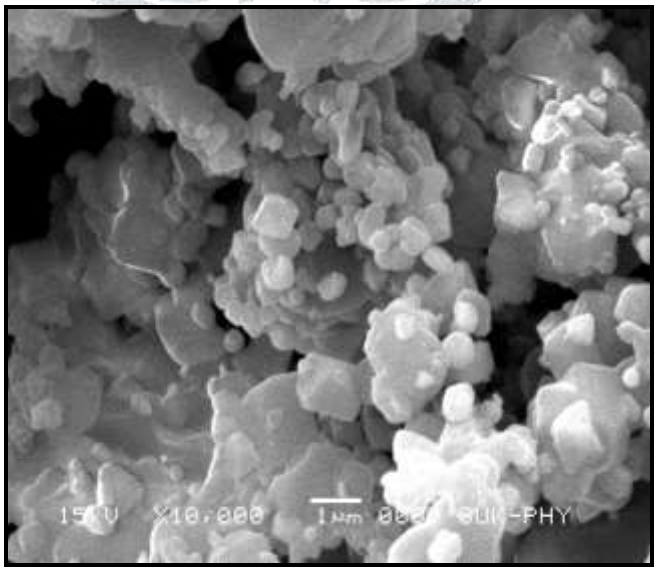

Fig. 2 SEM image of $ZnFe_2O_4$