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Synthesis and Characterization of $Zn_{0.5-x/2}$ Mg_x $Fe_{2\ (2.5-x/2)}$ O_4 Nanocrystalline ferrite Prepared by Auto-Combustion Method

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Abstract

Ferrites having chemical formula, $Zn_{0.5-x/2}$ Mg_x $Fe_{2\ (2.5-x/2)}$ O_4 with x = 0, 0.1 and 0.2 have been prepared by auto-combustion route. XRD confirms the absence of extra line formation the single phase of the ferrite samples. The patterns indicate well-defined peaks of crystalline FCC phase which confirm spinel cubic structure formation for the samples. Average crystallite size from Scherer Formula is found to be nano range. Infrared spectroscopy detects tetrahedral and octahedral metal ion complexes. Microstructure studied using Scanning Electron Microscope (SEM) gives dense like structure.

Keywords: *Spinel ferrites; XRD; Activation energy; Drift mobility; jump length;*

Introduction

Spinel nanocrystalline ferrites are one of the best magnetic semiconductors which have a great importance in telecommunication, microwave and electronics engineering. They are used in variety of applications ranging from simple function devices, like small permanent magnets, to sophisticated device used for the electronic industry [1,2]. Some interesting applications of these materials are found in computer peripherals, telecommunication equipments, permanent magnets, electronic and microwave devices, magnetic media used in computers, recording devices and magnetic cards. The electrical and magnetic properties are the most important properties of ferrites, which depend on the processing conditions, sintering temperature, chemical composition and the amount of the additives [3]. High electrical resistance and lower saturation magnetization (M_s) are the characteristics properties of soft ferrites which are not found in traditional soft ferromagnetic materials like silicon, steels or perm alloys [4].

In recent years, nanocrystalline ferrite materials are becoming a subject of intense research because of their unique properties, from the fundamental and the application point of view [5]. Ferrite with a spinel structure which is formed by a nearly closepacked FCC array of anions with holes partly filled by the cations can be represented by the formula M Fe_2O_4 [6], where M represents divalent metallic ions located in M interstitial (tetrahedral) sites and Fe metallic ions located in (octahedral) sites. Due to the large electronegativity of oxygen, the ionic type of bonds prevails in almost all oxide spinels [7]. Soft spinel ferrite (M Fe_2O_4, M = Co, Ni, Zn, Mn, etc.) nanoparticles have been intensively investigated due to their remarkable magnetic and electrical properties and wide practical applications in ferrrofluids technology magnetic drug delivery, magnetic high-density information storage etc [8, 9, 10].

The aim of our present work is to optimize a composition of the Zn-Mg based ferrite to achieve high-performance soft magnetic materials prepared using such a simple and low-cost method will be more promising in high-frequency applications and industrialization. Hence in the present paper, we have