The Microscopic Magnetic Properties of W-type Hexaferrite Powder Prepared by A Sol-Gel Route

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Abstract. Magnetic particles of W-type barium-calcium hexaferrite ($BaCa_2Fe_{16}O_{27}$) have been synthesized using a Stearic acid gel route. The gel precursors were dried at 100°C for 2 hrs and then calcinated at 650°C, 750°C, 850°C and 950°C for 4 hrs in a furnace and slowly cooled to room temperature in order to obtain barium-calcium hexaferrite particles.The microscopic magnetic properties of prepared samples studying using Mössbauer spectroscopy. Mössbauer spectra of all samples were recorded at room temperature. Mossbauer parameters like Isomer shift, Quadruple splitting etc. were calculated with respect to iron foil. Barium calcium hexaferrite samples heated at 650 °C,750°C, 850°C show relaxation type Mössbauer spectra along with paramagnetic doublet. The intensity of paramagnetic doublet increases with temperature confirm the presence of ferrous ions in the samples, where as sample calcinated at 950 °C confirm the presence of ferrimagnetic phase with partial super paramagnetic nature of prepared hexaferrite sample.

Keywords: Mossbauer spectra, W-type barium-calcium hexaferrite, sol-gel route.
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INTRODUCTION

Barium hexaferrite has been widely used as a hard magnetic materials for permanent magnet, high density recording media, bubble domain memories, high frequency devices and microwave devices mainly due to its unique chemical, structural, mechanical and magnetic properties The W-type hexaferrite is a very useful material for home appliances, electronic products, communication equipments and data processing devices due to its unique electrical and magnetic properties.[1,2] In present research paper we synthesized W-type $BaCa_2Fe_{16}O_{27}$ hexaferrite particles prepared using a Stearic acid gel route.[3] The Mossbauer spectroscopic study at room temperature of all prepared samples is reported.

EXPERIMENTAL

Hexaferrite samples with composition $BaCa_2Fe_{16}O_{27}$ were prepared using a Stearic acid sol-gel Method.[4] The stoichiometric amounts of AR grade powder of iron nitrate $(Fe(NO_3)_2).9H_2O$, barium hydroxide $(Ba(OH)_2)$, calcium nitrate $(Ca(NO_3)_2).4H_2O$ were mixed in an appropriate amount of a Stearic acid solution. The mixture was heated at 80°C -100°C for two hours under stirring and then cooled to room temperature. The gel precursor so formed was decomposed at 500°C for one hour and subsequently calcinated at 650°C, 750°C, 850°C, 950°C for four hours in air and slowly cooled in furnace to obtain $BaCa_2Fe_{16}O_{27}$ hexaferrite powder.

RESULTS AND DISCUSSION

Mössbauer spectroscopic measurements were performed in transmission geometry at 300K using a conventional spectrometer operating in a constant acceleration mode, with the gamma rays provided by a $^{57}Co(Rh)$ source in Pd matrix. The speed scale was calibrated using α-Fe lines. The Mössbauer spectrum was analyzed with a non-linear least-square routine, with Lorentzian line shape. Mössbauer spectra of $BaCa_2Fe_{16}O_{27}$ hexaferrite samples calcinated at 650°C, 750°C, 850°C, 950°C are shown in Figure 1. The spectra were fitted with five discrete sextets, corresponding to the five non equivalent crystallographic sites of W- type hexaferrite structure

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