FTIR study of Heat Treated Y-Co substituted M-Type hex ferrite

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Abstract

Present research work includes composites of $Ba_{0.8}$ $Y_{0.2}$ Fe $_{10.3}$ $Co_{1.7}$ O_{19} synthesized by sol-gel technique and sintered at 850, 950, 1050, and 1150 ˚C. The occurrence of two important peaks at 432 and 586 cm^{-1} in Fourier transform infrared (FT-IR) spectra offers idea of establishment of hexaferrite.

Keywords: FTIR study, sol gel method

1. Introduction

The interest in hexaferrites nanomaterials is mainly as a result of their possible technological applications in electronics devices and microwave absorption (stealth technology) [1] [2][3][4]. Out of different classes of hexaferrites, M-type show better properties such as high electrical resistivity, low eddy current, small width of ferromagnetic resonance line, excellent chemical stability, recording media and high coercivity [5][6][7]. The excellent magnetic nature of M-type hexaferrites is a outcome of the uniaxial magnetocrystalline anisotropy of Fe^{3+} ions that occur at the five crystallorgraphic sites namely octahedral (12k ↑, 4f2 ↓ and 2a ↑), trigonal bi-pyramidal (2b ↑) and tetrahedral (4f1 ↓) sites. Out of these five crystallorgraphic sites, three sites are having spin up whereas 2 are having spin down as shown by the arrow [2].

For decades, several methods of synthesis like solid state [8], sol-gel (SE)method [5], and co-precipitation method [9] have been cast-off to synthesize hexaferrites. However, SE method owe to its simplicity, low reaction time, homogeneity and low temperature of synthesis is one of the best methods. So present work employed sol-gel method and synthesized M-type barium hexaferrites with composition $Ba_{1-x}Y_xFe_{12-y}Co_yO_{19}$ (x=0.2 and y=1.7).

2. Experimental details

To synthesize M type barium hexaferrite $Ba_{1-x}Y_xFe_{12-y}Co_yO_{19}$ (x=0.2 and y=1.7) AR grade Barium nitrate $Ba(NO_3)_2$, Yttrium nitrate [$Y(NO_3)_3$.4H2O] , Cobalt nitrate [$Co(NO_3)_2$.6H2O], Ferric nitrate [($Fe(NO_3)_3$.9H2O] , Citric acid anhydrous [C_6 H_8O_7.H_2O] , Liquid ammonia . The liquid ammonia was used to keep the pH of the initial solution at 7. The citric acid to cation molar ratio was kept at 1:1. The mixture is heated with continuous stirring for 4 to 6 hours at nearly 80 °C using magnetic stirrer which converted solution into the viscous dark brown coloured gel. The temperature was increased to 300 °C so as to obtain the precursor material, Which was further calcinated at 850, 950, 1050, and 1150 °C for 8 hours.

3. Results and discussions

3.1 FTIR analysis

To check the functional group attached with samples, FTIR study has been performed. We have observed two prominent peaks at 427 cm^{-1} and 579 cm^{-1} indicates the occurrence of development of M-type hexagonal ferrites. These peaks arise due to stretching vibration of metal-oxygen bond of the octahedral and tetrahedral clusters of the hexagonal lattice [10][8]. Metal-Oxygen-Metal [11] is responsible for the peaks at 1434 cm^{-1} . We have also observed moisture and CO_2 which corresponds to band at 3447 cm^{-1} and at 2363 cm^{-1} respectively [12, 3].

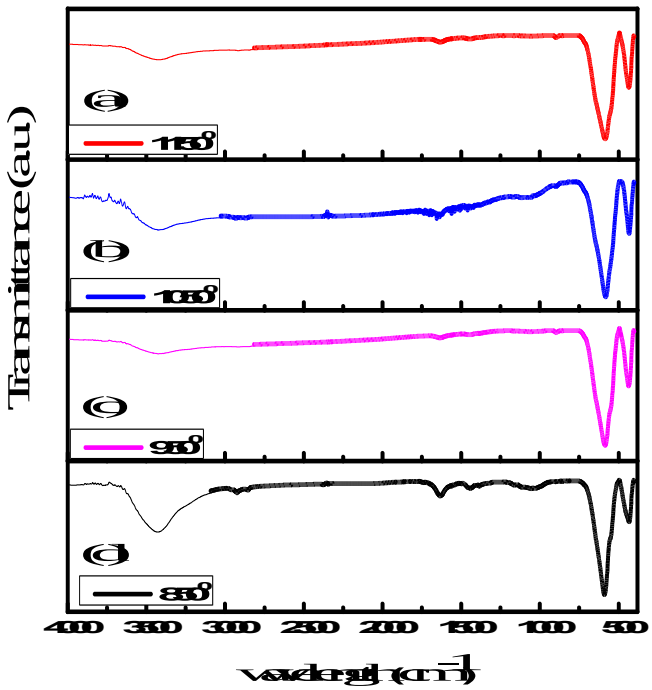

Fig. 1 FTIR spectra of $Ba_{0.8}Y_{0.2}Fe_{10.3}Co_{1.7}O_{19}$ at different temperature

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