ABSTRACT

Ferrites have been considered a highly important materials among others because of their extraordinary properties like high resistance, permittivity, high permeability, low eddy current loss, high curie temperature, higher magnetization and many more. During this time the characteristics of commercial ferrite materials both soft and hard ferrites have come to approach their theoretical value. So in present investigation we synthesized pure cobalt ferrite sample via co-precipitation method. The samples are synthesized at different temperature such as 700°C, 900°C, 1000°C and 1100°C for the optimization of its sintering temperature. Structural and magnetic properties of these samples are carried out by using x-ray diffraction, (XRD), field emission scanning electron microscope (FESEM), and vibrating sample magnetometer (VSM). XRD revealed the crystalline nature of cobalt ferrite samples. At 900°C we got excellent magnetic properties of cobalt ferrite with smaller grain size.

After the optimization of sintering temperature of cobalt ferrite, a series of cobalt substituted barium hexaferrite with composition BaCo$_x$Fe$_{12-x}$O$_{19}$ with $x= 0.0 -1.0$ in steps of 0.2 has been prepared via co-precipitation method. All these samples are synthesized at low sintering temperature of 900°C. After the completion of synthesis process these samples are characterized by using different characterization techniques. XRD, FESEM, TEM, RAMAN and FTIR are used to study the structural and spectroscopic properties of cobalt substituted barium ferrite. Magnetic and electric properties of these samples are studied by using VSM and VNA. From all these six samples, at $x= 0.8$ we get excellent value of permittivity (6-6.5) & permeability (1-2) in X band (8-12GHz). These values make this material a perfect candidate for high frequency application and the substrate for antenna applications. Moreover the maximum saturation of 66 emu/g and higher coercivity (3000-4000Oe) also makes this material a strong contender for recording media.

In next step we explored this material with samarium (REE) ions. A series of samarium doped Ba-Co hexaferrite have been synthesized with composition BaCo$_{0.8}$
Sm$_x$Fe$_{11.2-x}$O$_{19}$ with $x = 0.0 - 1.0$ in steps of 0.2. similar properties are carried out as mention in previous composition. With addition of samarium ions in barium lattice a rapid decrease in the value of saturation magnetization is observed. Similar effect is observed in structural and spectroscopic properties. Excess of samarium ions is responsible for the distortion in crystal structure. Hence from this investigation we found the excellent magnetic and sustained electromagnetic properties of cobalt substituted M-type barium hexaferrite. Moreover we invent a new composite of barium and cobalt i.e. BaCo$_{0.8}$Fe$_{11.2}$O$_{19}$ with excellent structural, magnetic and electromagnetic properties in high frequency range (8-12 GHZ) which has multitude of applications.

**Keywords:** Co-precipitation, M-type hexaferrite, Sintering, Strain & Electromagnetic properties