Summary:
The word ‘Ferrite’ has been extensively used for those materials having ferric oxide as one of the ingredients. Ferrites belong to the group of ferromagnetic materials and crystallize into different crystal forms like cubic, hexagonal and distorted perovskite or orthorhombic. They can be classified into three main groups depending upon their crystal structure i.e spinel, garnet and hexaferrite. The hexaferrites possess a group of ferromagnetic oxides possessing crystal structure closely related hexagonal crystal structure. Hexagonal ferrites are very attractive materials for high frequency circuits and operating devices. Barium hexaferrites are used for high density, over-coat free contact or semi-contact recording media. On account of large magnetocrystalline anisotropy constant strong dependence of the orientation of easy axis on the microstructure, they have potential for application in both perpendicular and longitudinal magnetic recording media. Barium hexaferrites exhibits a very high coercivity, excellent chemical stability and corrosion resistance, which makes it suitable for permanent magnet. Because of their significant applications in industries, several form of substitution in hexaferrites have been tried to improve hard magnetic properties. In the present work the hexaferrites are prepared by a Stearic acid gel method.
The lack of experimental information about W-type allows to start a systematic studies (structural, thermal, dielectric and magnetic) of Ba-Ca hexaferrite. The effect of cobalt substitution, surfactant in barium calcium hexaferrite is studied. The effect of heat treatment condition temperature and surfactants on the M- type Barium Magnesium hexaferrite is systematically studied. Different methods have been adopted inorder to prepare barium hexaferrite powders with the desired particle size, morphology and homogeneity. Among the several techniques a versatile method for preparing the hexaferrites at low temperature is the sol-gel and coprecipitation method. In sol-gel techniques, the annealing temperature necessary in the crystallization process is lower. Barium ferrite particles of high purity can be
synthesized in a short duration by using present techniques. The Stearic acid gel method is a low cost technique to prepare hexaferrites. In the present work two types of hexaferrite W-type and M-type has been studied. The crystal structure of W-type hexagonal ferrite is very complex and can be considered due to the superposition of R and S blocks along the hexagonal C-axis with the crystal structure of $RSSR*S*S^*$. The crystal structure of M-type hexaferrite can be built up from spinel blocks of two oxygen layers being S and S*, which are connected by a block R containing the barium ion, where R is a three oxygen layer block with composition $Fe_8O_8$. M-type hexaferrite has an crystallographic structure $RSR*S^*$, where * means the respective block is turned 180° around the hexagonal axis. In M-structure the spinel block consists of two or more $O_2$ layers. The following hexaferrite series were prepared using a Stearic acid gel method:

I) $BaCa_2Fe_{16}O_{27}$ (with calcinations temperature 650°C, 750°C, 850°C, 950°C and 1050°C) with and without surfactant.

II) $BaCa_{2-x}Co_xFe_{16}O_{27}$ (where $x = 0.4, 0.8, 1.2, 1.6$ and 2.0) with and without surfactant (CTAB) calcinated at 950°C.

III) $BaMg_2Fe_{10}O_{19}$ (with calcinations temperature 650°C, 750°C, 850°C and 950°C) is prepared without surfactant and with CTAB as a surfactant.

IV) $BaCa_2Fe_{16}O_{27}$ hexaferrite, calcinated at 950°C was synthesized by using a microemulsion technique for comparative studies.

V) $BaCa_2Fe_{10}O_{19}$ is prepared by using chemical coprecipitation method for comparative study.
Prepared hexaferrite particles were characterized by using various experimental techniques like X-ray diffractometry, Scanning electron microscopy, Fourier Transform Infrared Spectroscopy, thermal analysis and magnetic measurements. The role of surfactant on the morphology of the prepared Barium Calcium hexaferrite, Cobalt substituted Ba-Ca hexaferrite have been studied. The variation in heat treatment techniques change the morphology of prepared hexaferrite particles. Room temperature dielectric measurements were carried out at low frequency.

It was observed that surfactant plays crucial role in the formation of pure ferrite phase. Addition of surfactant increases the phase formation for both M-type and W-type hexaferrite. Surfactants play an important role in controlling the morphology of prepared hexaferrite particles. Without surfactants one obtained the agglomeration of particles, of BaCa2Fe16O27, use of Tween-80 surfactant for the same sample shows the separated particles of hexaferrites whereas use of SDS surfactant give rise to elongated hexaferrite particles. Addition of surfactant decreases the saturation magnetization and coercivity of prepared BaCa2Fe16O27 hexaferrite. The thermal stability of the hexaferrite powder can be increased in presence of surfactant. Calcination condition controls the morphology of the particles. Compared to the samples calcined in a furnace, the samples sintered in microwave oven shows pure M-phase and separate particles. The materials prepared in the present work find the applications in microwave frequency range. It can be used in magnetically operated devices and as a radar absorbing material. This work will be continued further for detail study.