CHAPTER 1
INTRODUCTION

Motivation

The material presently being used for magnetic recording is the γ-phase of Fe_2O_3. A possible replacement for this material for use in high density recording is the M-type barium hexaferrite. This ferrite is attractive for this purpose because it has a high anisotropic field, it is mechanically hard and it is chemically stable. To be used as a high density recording material, the hexagonal ferrite powders must be of an optimal size with a small aspect ratio (the ratio between the diameter d and the thickness t (d/t)). Each of the particles must be aligned with their c-axis perpendicular to the substrate surface and have small diameters. Magnetic grains with diameters of 0.1 μm are needed to obtain the correct signal to noise ratio. The diameters of the powder can be modified during the sintering step in the solid state reaction process of fabrication of this material. Changing the calcination temperatures or the soaking times can achieve this. The drawback of the solid state reaction method is that high temperatures are needed. If the temperature is too low, the solid state reaction will be incomplete. Too high temperature will lead to the destruction of crystalline structure. Also the cost of calcinating at high temperatures will be high. The use of sintering aid can lower the require processing temperature. This will, however, lead to changes in the particle size and to the magnetic properties of the samples.

Other fabrication methods should be considered. The co- precipitation method is one of these. It has many advantages such as intimate mixing of the chemical constituents, chemical homogeneity and lower firing temperature. The sizes of the particles can then be increased by additional heating. High calcination temperatures will cause the grains growth, while low calcination temperatures will lead them to be small or fine. Desired changes in the magnetic properties can be obtained by adding dopants to the chemical formula. The changes will depend to a great extent on which Fe site in the M-type structure the dopant ions go into. In general, the preference is determined by the

relative sizes of the ions involved, i.e., the size of the dopant ions relative to the size of the sites into which ions substitute.

Objective:

1. To study the effect of the calcination temperature and doping materials on morphology of barium ferrite synthesized by the co- precipitation method
2. To explain the observed change in term of what site in magnetopumbites structure the non magnetic dopant ions substituted into .
3. To investigate the magnetic properties which are altered by changes in the grain size and morphology caused by the doping of the Barium hexaferrites.

Scope

The scope of this research are as follow:

1. Determine how barium ferrite powder can be prepared by the co- precipitation
2. Substitute Co and Sn into the barium ferrites to achieve the co-doped hexaferrite $BaFe_{12-2x}Co_xSn_xO_{12}$ when x=0.00,0.25,0.50,0.75 and 1.00
3. Change the calcination temperature by steps of 50° C, i.e. soak the co-precipitated powders for 4 hours at 950, 1000, 1050, 1100,1150 and 1200°C.
4. Measure the following properties of $BaFe_{12-2x}Co_xSn_xO_{12}$; the phase transitions, the microstructure and several magnetic properties

Research Procedure

1. Prepare the chemicals and learn how to use the equipment
2. Synthesis the barium ferrites by co-precipitation for different dopants ions concentration
3. Heat treat the synthesized powder at different temperatures
4. Characterize the powder, i.e., carry out a chemical analysis, measure the phase changes, measure the particle morphology, determine the particle sizes.

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5. Measure the following magnetic properties; coercive force and saturation magnetization
6. Analyze the data.
7. Arrive at some conclusion.

Expectation of Achievement

To determine what is the most important parameter which the magnetic properties (coercivity) of doped barium ferrite powder depend on.

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