CHAPTER 1

INTRODUCTION

1.1 Background of Ferrites Technology

Magnetite or ferrous ferrite (a natural occurring ferrite) has been known since ancient times. It has been applied as lodestone using its weak permanent magnetism. [16]

In 1909, Hilpert [1] made a first systematic study on the relationship between chemical and magnetic properties of various binary iron oxides. Then, Snoek [2] in 1936 and his co-worker laid the foundations of the physics and technology of practical ferrites. Furthermore, similar studies in Japan were also reported by Takei [3] in 1937. Snoek has stated that the most important property of a material for core inductor is the loss factor, which is the loss tangent divided by the permeability. After the discovery by Snoek, the application of ferrites has become established in many telecommunication and electronic application.

In recent years, the trend in electronics applications has been for an increasingly compact design. Electronic equipment is becoming smaller in size, lighter, multi functional and high performance. Miniaturization technology is essential to make portable products such as video camera, notebook computer, hard disk drives, cellular phone, portable radio and etc. These electronic equipment will not only change our life style but they become important and necessary in our life.

1.2 Introduction To Ferrites Technology

Ferrite may be defined [4] as magnetic materials composed of oxides containing ferric ions as the main constituent. Ferrites are ferromagnetic materials (ceramics) in spinel structure, which are dark grey or black in appearance, very hard, brittle and have electronically insulating properties [5]. It is used in high frequency applications, where eddy current losses are significant. Generally, the composition of ferrites is

(MO) (Fe_2O_3), where **M** is typically a divalent metal. For magnetically soft ferrites, **M** is Fe, Mn, Zn or Ni. [33]

Ferrites can be synthesized by co-precipitation technique and thermal decomposition of metal oxalates [6, 7]. They also can be synthesized by thermal decomposition of mixed metal acetate complex [8], by electrolytic co-precipitation [9], spray drying of mixed sulphate solution [10] and by atomizing burner technique [11].

The important parameters of ferrites are the saturation magnetization, curie temperature, magnetocrystalline and magnetostrictive anisotropy, which are determined by the choice of the cations and their distribution over the various sites. In addition, microstructure also plays an important role in determining the properties of ferrites. Therefore, grain size, porosity, chemical homogeneity and foreign inclusion will affect the permeability, remanence and coercivity of the ferrites materials. [33]

Soft ferrite magnetic materials usually possess low coercivity, low hysteresis losses, high permeability and are easily magnetized and demagnetized, which is important in low magnetic field application. It must also be free from structural defects, such as particles of a nonmagnetic phase or voids in the magnetic materials, which tend to restrict the motion of domain walls and thus increase the coercivity.

1.3 Soft Ferrites Applications

Soft ferrites are used in devices that are subjected to alternating magnetic fields and where low energy losses are required, such as transformers, inductors, recording heads, microwave devices and etc.

Since the electrical resistivity of soft ferrites is $10^6 - 10^{11}$ times that of metals, ferrites component have much lower eddy current losses and hence are used at frequencies generally above 10 kHz [12].

1.4 Objective

The purpose for this research is to make a comparison and selection for the best processing route yielding the optimum properties.

MgCuZn Ferrites are a new family of ferrites that are not widely used in electronic equipments. Therefore, a study on the production of MgCuZn Ferrites by two processing routes will be conducted, which are the ***Mixed Oxide*** route and the ***Co-Precipitation*** process.

Specimens with different calcination and sintering temperatures will be produced by the mixed oxide route and the co-precipitation process, in order to study the effect of these temperatures on the MgCuZn Ferrites.

Specimens derived from these processing routes will be characterized by electromagnetic measurement. This is done in order to ensure that MgCuZn Ferrites are suitable to use in multilayer chip inductors without exceeding the melting point of silver.

Finally, a comparison between these processes will be made in order to select the best processing route with optimum properties and the lowest production cost.