# EFFECTS OF $Mg_2TiO_3$ (MT) ADDITION ON DIELECTRIC PROPERTIES OF $CaCu_3Ti_4O_{12}$ (CCTO)

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## ABSTRACT

### EFFECTS OF $MgTiO_3$ (MT) ADDITION ON DIELECTRIC PROPERTIES OF $CaCu_3Ti_4O_{12}$ (CCTO)

This project studied the effect of $MgTiO_3$ (MT) addition on $CaCu_3Ti_4O_{12}$ (CCTO). Recently an oxide ceramic CCTO was reported that exhibits very high dielectric constant value, which is desirable for many microelectric applications. However, the dielectric loss of the material is relatively and become less useable. Therefore, in this work, CCTO is doped with MT in order to lower the dielectric loss. The MT-doped CCTO was prepared by using solid state reaction method. The MT doped with CCTO, calcining at 1000°C for 12 hours and sintered at 1100°C for 24 hours. Effect of MT dopant to the dielectric properties of CCTO had been studied. The high dielectric constant and low dielectric loss was observed at 0.1, and 0.2 MT dopant compared from its pure samples (X= 0). However for 0.3 MT dopant was dropped from high value of dielectric constant to the lowest value and result in high dielectric loss. Over the wide frequency range, 0.1 MT was more stable then other samples that always present high dielectric constant and low dielectric constant compared with undoped CCTO and other sample. This result indicates that certain MT dopant can be used to improve the dielectric properties of CCTO.

# CHAPTER 1

# INTRODUCTION

## 1.0 Background

Materials with high dielectrics constants are widely used in microelectronic devices such as capacitors, resonators and filters as demanded by miniaturization of microelectronics devices. Recently, the complex perovskite compound $CaCu_3Ti_4O_{12}$ (CCTO) was attracted considerable due to its high dielectric constant. The interesting part of the high dielectric behavior leads this material to a big number of technological applications. According to M.A Subramanian et al. [1], $CaCu_3Ti_4O_{12}$ displayed some interesting behavior on the dielectric constant, which shows a high value of about 12,000 at 1 KHz in temperature range between 100 K and 400K with exhibit no phase transition. Although this material show giant dielectric constant behavior with small dependence on the temperature its generally associated to dielectric loss (tan $\delta$) or relaxor properties which is relatively high at frequency 1 KHz which about 0.1 at room temperature.

The origin of this giant dielectric constant and its weak temperature dependence has become a new area of interest. Adams et al. [2] explained the dielectric behavior of CCTO does not come from its intrinsic character but originated from some heterogeneity of its ceramic structure. There is no structural phase transition in the whole temperature range, this indicate that permittivity doesn't come from the displacement of Ti ions, instead it is possibly due to dramatic decrease originates from the dielectric relaxation of the samples. However, during the sintering process of $ATiO_3$- based samples (where A= Ca, Sr, and Ba), they lost small amounts of oxygen and became conductive.