UNIVERSITI TEKNOLOGI MARA

EFFECTS OF $(Ba_{0.6}Sr_{0.4})TiO_3$ CERAMIC AND $ZnO\text{-}TeO_2$ GLASS DOPING ON DIELECTRIC PROPERTIES OF $CaCu_3Ti_4O_{12}$ CERAMICS

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

In this study, the separate effects of $(Ba_{0.6}Sr_{0.4})TiO_3$ (BST) ceramics and $ZnO\text{-}TeO_2$ glass additions on dielectric properties of $CaCu_3Ti_4O_{12}$ (CCTO) ceramics were investigated and prepared from high purity oxide powders by the conventional solid state synthesis method . For the first series, (1-x)CCTO- (x)BST (x=0,0.05, 0.1, and 0.2) composite, X-ray diffraction (XRD) analysis showed the existence of BST as a secondary phase alongside CCTO. Scanning electron microscopy (SEM) showed a slight decrease in grain size of doped CCTO samples. Addition of BST into CCTO caused the dielectric constant to slightly decrease but improved stability with frequency compared to the undoped sample. The decrease in dielectric constant of doped CCTO samples was suggested to be partly due to the decrease in average grain size and increase in porosity with BST addition. The dielectric loss (tan δ) of CCTO reduced by the BST addition and probably due to the increase of grains boundary resistivity. The activation energy of grains boundary (E_{gb}) showed higher values as compared to the activation energy of grains (E_g) for all samples and conforms to the internal barrier layer capacitor (IBLC) model. For the second series (1-x)CCTO-(x)($ZnO\text{-}TeO_2$) (x=0,0.01, 0.03, and 0.05) glass composite, X-Ray diffraction investigation showed single phased CCTO for all samples without presence of any crystalline phase related to $ZnO\text{-}TeO_2$. Scanning electron microscope (SEM) showed the grain size of CCTO ceramics increased with increasing addition of $ZnO\text{-}TeO_2$ glass additive. The addition of $ZnO\text{-}TeO_2$ glass improved the dielectric constant of CCTO for entire frequencies probably due to the increase of grain size of CCTO ceramics. In addition, it was found that the dielectric loss of CCTO reduced by the $ZnO\text{-}TeO_2$ glass addition and it was suggested to be due to the increase of grain boundary resistivity. The resistance of grains boundary (R_{gb}) showed higher values as compared to the resistance of grains (R_g) for all samples and the large difference between the resistances also conforms to the IBLC model.

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