

Development of High Dielectric Constant Materials Based on Bismuth Copper Titanium Oxide



Thesis submitted in partial fulfilment

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Doctor of Philosophy

By

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Chapter 7

*Summary and Future
scope*

7.1. Summary

- $\text{Bi}_{2/3}\text{Cu}_3\text{Ti}_4\text{O}_{12}$ (BCTO), $\text{Bi}_{2/3}\text{Cu}_{3-x}\text{Mg}_x\text{Ti}_4\text{O}_{12}$, $\text{Bi}_{2/3}\text{Cu}_{3-x}\text{Zn}_x\text{Ti}_4\text{O}_{12}$, $\text{Bi}_{2/3}\text{Cu}_{3-x}\text{Ni}_x\text{Ti}_4\text{O}_{12}$ ($x=0.05, 0.1$ and 0.2), $\text{Bi}_{2/3}\text{Cu}_3\text{Ti}_{4-x}\text{Ge}_x\text{O}_{12}$ and $\text{Bi}_{2/3}\text{Cu}_{3-x}\text{Zn}_x\text{Ti}_{4-x}\text{Ge}_x\text{O}_{12}$ ($x=0.05$) ceramics were successfully synthesized by semi-wet/Chemical route at low temperature and single phase formation was confirmed by XRD studies.
- The elemental compositions of all these ceramics obtained by EDX data were fit as per stoichiometric ratio of the elements present in the ceramics.
- Dielectric constant of BCTO ceramic was found the highest (3024 at 423 K and 100 Hz) among the synthesized doped BCTO ceramics while its dielectric loss was also found high (0.45) among doped BCTO ceramics.
- Dielectric loss was found lowest (0.07 at 310 K and 10 kHz) for BCNTO-0.2 ceramic among all synthesized ceramics.
- Microstructural analysis were performed by SEM and TEM analysis.
- Oxidation states of the elements present in the ceramics, were confirmed by XPS.
- The existence of grain and grain boundary was confirmed by the Impedance analysis.
- The electrical conductivity of all the ceramics increase with increase in frequency and temperature satisfying Arrhenius and Johncher's power law respectively.
- From Electrochemical studies, It is concluded that All the synthesized ceramics are pseudo capacitive in nature and can be used in the energy storage devices.

7.2. Future scope

In general, this work has been important for nature. The everyday increasing demand for various applications, semiconducting technology sustain blest in its drive for high transistor densities and faster transistor.

Ceramic has inorganic and non-metallic materials constituted from metal and a non metal compounds. Now a days ceramic materials have enormously expanded many possible applications. Most of the new materials have been used in our daily life. There is a strong effort of researcher to discover the new ceramics and their metal doped components for various applications. These ceramics have been played an important role in industrial application.

- The Bismuth Copper Titanium Oxides ($\text{Bi}_{2/3}\text{Cu}_3\text{Ti}_4\text{O}_{12}$) may be used in various applications because of its high dielectric constant and low dielectric loss.
- The metal doped BCTO Ceramics show enhanced properties as compared to its parents components and may be used in capacitors, microelectronic devices and electronic chips, transistors.
- The properties of ceramics largely depend on the synthesis route, sintering duration and sintering temperature. In future, these composite may be studied by changing the synthesis route and sintering condition.
- The internal properties of the composite may be studied by impedance analysis to see the electrical and dielectric properties of grain and grain boundaries.