Synthesis and Characterization of some Rare Earth Metals doped Bismuth Copper Titanate Ceramics

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for the Award of Degree
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by
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7.1. Summary

- $Bi_{(2/3)-x}Nd_xCu_3Ti_4O_{12}$, $Bi_{(2/3)-x}Sm_xCu_3Ti_4O_{12}$, $Bi_{(2/3)-x}Gd_xCu_3Ti_4O_{12}$, and $Bi_{(2/3)-x}Dy_xCu_3Ti_4O_{12}$ (x= 0.05, 0.1 and 0.2), ceramics were successfully synthesized by semi-wet at low temperature and the phase formation was confirmed by XRD studies.
- Microstructural analysis was performed by SEM, AFM and TEM analysis.
- The elemental compositions of all these ceramics obtained by EDX data were fit as per stoichiometric ratio of the elements present in the ceramics.
- Oxidation states of the elements present in the ceramics, were confirmed by XPS.
- Dielectric constant of all doped BCTO ceramics was found to be decrease as compared to the Pure BCTO which is synthesized by semi wet method but corresponding dielectric loss was also declined. The dielectric constant as well as tangent loss of all doped ceramics are almost independent in the higher frequency region.
- The investigation of dielectric characteristics reveals that the dielectric loss at higher frequencies is less than one, emphasizing that the synthesized material can be a good option of material for high-frequency applications.
- Dielectric loss was found lowest (0.04 at 303 K and 1 kHz) for BSCTO-0.2 ceramic among all synthesized ceramics.
- The electrical behavior of grain and grain boundary was confirmed by the Impedance analysis.
- The electrical conductivity of all the ceramics increases with increase in frequency and temperature satisfying Arrhenius and Johncher's power law respectively.

- The difference between the size of dopant and bismuth in the $Bi_{2/3}Cu_3Ti_4O_{12}$ leads to the change in the dielectric behavior and other parameters.

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.

- Bismuth Copper Titanium Oxides ($Bi_{2/3}Cu_3Ti_4O_{12}$) have a high dielectric constant and can be employed in different applications. However, their high dielectric loss restricts its usage in microelectronic devices. As a result, there is a requirement to improve the loss of the ceramics while retaining its dielectric constant, and ions doping or substitution are utilized to achieve this.

- The elements 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 composites 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.