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Influence of rare earths on the electromechanical coupling factor and operating temperature of strontium bismuth titanate

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Piezoelectric ceramics are widely studied for numerous electronic functional device applications, e.g. in microprocessors resonators, mobile communications filters, inject printers' actuators and for detecting shock sensors and hard disc drives, etc. The piezoelectrics used for these applications are commonly Lead based materials because of their good piezoelectric behavior. These Lead based piezoelectrics have two major deficits viz. low operating temperatures and toxicity. Keeping these factors in view, the present study attempts to find alternate environment friendly piezoelectrics with good piezoelectric properties and enhanced operating temperatures. Strontium Bismuth Titanate is a suitable alternate piezoelectric.

Strontium Bismuth Titanate $SrBi_4Ti_4O_{15}$ (SBT), a member of the Bismuth Layered Structured Ferroelectric (BLSF), is gaining attention because of its Curie temperature and its ability to be tailored for required applications with suitable composition modifications. The higher Curie temperature (535°C) makes it useful for applications at higher temperature. The electromechanical coupling factor of SBT is around 0.40 while that of PZT is of the order of 0.70. The present study analyses the influence of rare earth substitution and the preparation method on the electromechanical coupling factor and Curie temperature of lead free piezoceramics.

This paper evaluates the impact of Rare Earth (RE) substitution on $SrBi_4Ti_4O_{15}$ (SBT), (RE: Zirconium (Zr), Samarium (Sm), Neodymium (Nd), Holmium (Ho), Praseodymium (Pr), Dysprosium (Dy)) and also the impact of processing method on Curie temperature and kp (electromechanical coupling factor) of SBT. The temperature at which phase transition from ferroelectric to paraelectric phase occurs is called the Curie temperature (Tc). In this study, the dielectric constant of La-substituted (SBT), Sm- substituted (SBT), Nd- substituted (SBT) has proved to decrease and the TC increased for all the RE substituted $SrBi_4Ti_4O_{15}$ except for that with Zr.

An increase in the Tc is observed due to the rare-earth ions substitution and the piezoelectric behavior is enhanced with the increase in rare-earth ions content making these materials useful for piezoelectric applications at temperatures greater than 550°C.

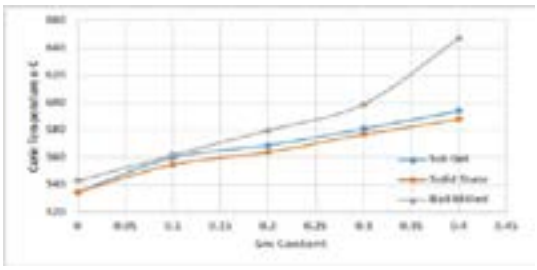

Figure 1: Curie temperature of Sm substituted SBT

Biography

Dr Pasala Sarah, Professor and Dean, R&D, is an accomplished academician with over 20 years of teaching experience blended with additional experience in Research & Administration. The Research experience includes execution of research projects in identifying materials for different needs of the Industry. Her administrative experience includes Vice Principal, Head and Dean Portfolios in large Engineering College of over 2500 students. She has a passion for teaching and is instrumental in bringing in outcome based teaching-learning process to enhance quality of both teaching and learning. Dr.Sarah has unique experience of blending her core competency of Physics with modern technological practices which enable the students to Innovate, Adapt to change and Adopt to the new technologies in the realm of Physics.

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