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Title: Synthesis and Characterization of Ferroelectric Composites and their Applications

In the first chapter we have given a brief introduction about the classification of insulator and ferroic materials.

In chapter 2 the crystal structure of Bismuth ferrite ($BiFeO_3$ or BFO) and ($BaTiO_3$ or BTO) are described. Further a comprehensive review on the research carried out on BFO, BTO and BFO-BTO composites is also summarized. In the end, the chapter concludes with the motivation and objectives of the present work.

Chapter 3 details the processing methodology adopted for the synthesis of pure phase BFO and doped 0.7BFO-0.3BTO composites. Also, a brief description of the various characterization techniques employed for studying structural, dielectric, ferroelectric, magnetic and piezoelectric properties are given.

In chapter 4 we optimized the synthesis parameters of phase pure rhombohedral perovskite bismuth ferrite without leaching. Effects of precursors' grinding time, heating/cooling rate and sintering temperature on the phase, structural and spectral properties of synthesized materials were systematically studied using XRD, Rietveld refinement and FTIR.

Chapter 5 describes the effect of Mn doping on the structural, spectral, electrical, ferromagnetic and piezoelectric properties of 0.7BFO-0.3BTO lead-free ceramics. In this, lead-free $0.7BiFeO_3$-$0.3BaTi_{1-x}Mn_xO_3$ ceramics were prepared by conventional solid state reaction method. All the ceramics were calcined at the optimum temperature of 800 ^oC to minimize the impurity phases to a great extent. The synthesized ceramics have a co-existence of R and T phases with a space group of *R*3*c* and *P*4*mm* respectively with a small amount of $Bi_{25}FeO_{40}$ impurity.

In chapter 6 lead-free $0.7Bi_{0.95}Sm_{0.05}Fe_{1-x}Ga_xO_3$-$0.3BaTiO_3$ and $0.7Bi_{1-x}Sm_xFe_{0.95}Ga_{0.05}O_3$-$0.3BaTiO_3$ are synthesized and studied their enhanced electric, ferromagnetic and ferroelectric properties of Samarium and Gallium co-doped 0.7BFO-0.3BTO lead-free ceramics near morphotropic phase boundary.

Finally in the last chapter 7, the conclusion and future prospects of the research work have been discussed.