

Synthesis, characterization, and effect of doping on the optical and electrical properties of layered ferroelectric ceramics

Ahmed Abourrig^{1*}, Mohamed Afqir¹, Mohamed Elaatmani¹, Amina Tachafine² and Didier Fasquelle²

¹Faculty of Sciences, Physical Chemistry of Materials and Environment, Cadi Ayyad University, Marrakesh, Morocco

²Unit for Dynamics and Structure of Molecular Materials (UDSMM), Blaise Pascal Research Center, Université du Littoral Côte d'Opale, 50 rue Ferdinand Buisson, B.P. 717, 62228 Calais, France.

***Email:** a.abourrig.ced@uca.ac.ma

Abstract: Aurivillius phases are layered perovskite-type oxides described by the general formula $A_{n-1}Bi_2Bi_2O_{3n+3}$ where A corresponds to a large cation in 12-fold coordination, while B corresponds to a smaller cation in octahedral (6-fold) coordination [1]. In this study, praseodymium (Pr)-doped $SrBi_2Nb_2O_9$ ($x = 0.0, 0.1, 0.2, 0.3, 0.4$ and 0.5) ceramics were synthesized via a conventional solid-state reaction using carbonate, oxide, and nitrate precursors dissolved in a citric acid–ethylene glycol solution. X-ray diffraction analysis confirmed that the samples crystallized in the orthorhombic structure typical of $SrBi_2Nb_2O_9$, with a gradual decrease in unit cell volume upon Pr incorporation. FTIR spectroscopy revealed vibrations associated with the NbO_6 octahedra, while photoluminescence measurements confirmed the presence of Pr^{3+} ions. UV-Vis spectroscopy indicated a direct band gap whose value depends on the doping level. The Curie temperature, which remained constant across different frequencies, confirmed the normal ferroelectric behavior of the ceramics. The ferroelectric transition was found to be more sensitive to the Pr substitution site than to its valence, showing no linear correlation with Pr^{3+} concentration. At room temperature, Pr doping did not significantly affect dielectric loss, whereas at elevated temperatures, electrical conduction was dominated by doubly ionized oxygen vacancies and a hopping mechanism [2].

Keywords: Characterization doping ceramics optical conductivity dielectric

References

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