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Effect of Sn Doping on the Curie Temperature, Structural, Dielectric and Piezoelectric Properties of Ba0.8Sr0.2Ti1−xSnxO3 Ceramics

Abstract

Ba0.8Sr0.2Ti1−xSnxO3 material with varying Sn concentrations (x = 0, 0.02, 0.04, 0.06, 0.08, and 0.10) was synthesized using the conventional solid-state reaction method. X-ray diffraction (XRD) analysis reveals that as the Sn concentration increases from x = 0 to x = 0.10, the Ba0.8Sr0.2Ti1−xSnxO3 undergoes a structural phase change from tetragonal to cubic. Dielectric analysis of Ba0.8Sr0.2Ti1−xSnxO3 shows a significant drop in Tc, from 65 to 5°C, caused by the replacement of Sn4+ ions with larger ionic radii compared to Ti4+ ions at the B-sites. The composition with x = 0 exhibits the largest dielectric constant due to its enormous spontaneous dipole moments. Conversely, the substitution of Sn in Ba0.8Sr0.2Ti1−xSnxO3 reveals a decrease in the dielectric constant at the B-site structure of perovskite, resulting in a reduced tolerance factor and a decrease in the tetragonality of the sample. However, the pinching effect significantly enhances the dielectric constant of the sample with x = 0.10. Grain size measurements for x = 0 demonstrate a well-distributed grain structure. Additionally, the undoped sample exhibits a higher piezoelectric constant than the Ba0.8Sr0.2Ti1−xSnxO3 samples. According to the piezoelectric constant data, the composition with a tetragonal structure appears to have a greater piezoelectric constant than the cubic structure.

Keywords

BaTiO3; BST; BSTS; Ceramic; dielectric; XRD