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Temperature-dependent dielectric relaxation and high tunability of $(Ba_{1-x}Sr_x)TiO_3$ ceramics

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Abstract

$(Ba_{1-x}Sr_x)TiO_3$ (x = 0.35, 0.50, abbreviated as BST35 and BST50, respectively) ceramics were prepared by sol-gel route. We researched their dielectric relaxation and tunability in a large temperature range of 150 to 950 K. The dielectric tunabilities and figure of merit of BST35 and BST50 ceramics at 288 K were 68.58% and 54.6, 19.4% and 114, respectively, which indicated the ceramics are promising candidates for tunable capacitor applications. Sr^{2+} doping can reduce the phase transition temperature of ferroelectric to paraelectric. The dielectric diffuse in the dielectric relaxation was observed in the high temperature region. A broad dielectric maximum shifted to higher temperature with increasing frequency, signifying the relaxor-type behavior of these ceramics. Impedance and dielectric measurements were studied to analyze their temperature dependence of dielectric properties. A single frequency arc observed in Cole-Cole plots of BST35 ceramics suggested the relaxations mainly correspond to a grain boundaries response; while two frequency arcs indicated both grain and grain boundaries contribute to the dielectric relaxation of BST50 ceramics. The activation energy for relaxation and conduction was calculated, which suggested the oxygen vacancies play a critical role in the dielectric relaxation process of $Ba_xSr_{1-x}TiO_3$ ceramics at high temperatures.

Keywords: BST ceramic; Dielectric relaxation; Tunability; Oxygen vacancy

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