

Residual Ferroelectricity in Barium Strontium Titanate Thin Film Tunable Dielectrics

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Abstract: Loss reduction is critical to develop $Ba_{1-x}Sr_xTiO_3$ thin film tunable microwave dielectric components and dielectric energy storage devices. The presence of ferroelectricity, and hence the domain wall contributions to dielectric loss, will degrade the tunable performance in the microwave region. In this work, residual ferroelectricity—a persistent ferroelectric response above the global phase transition temperature—was characterized in tunable dielectrics using Rayleigh analysis. Chemical solution deposited $Ba_{0.7}Sr_{0.3}TiO_3$ films, with relative tunabilities of 86% over 250 kV/cm at 100 kHz, demonstrated residual ferroelectricity 65 degrees C above the ostensible paraelectric transition temperature. Frequency dispersion observed in the dielectric temperature response was consistent with the presence of nanopolar regions as one source of residual ferroelectricity. The application of AC electric field for the Rayleigh analysis of these samples led to a doubling of the dielectric loss for fields over 10 kV/cm at room temperature. (C) 2014 AIP Publishing LLC.