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Authors: Aurang Zeb, Saeed ullah Jan, Faith Bamiduro, David A. Hall, Steven J. Milne

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Temperature-Stable Dielectric Ceramics based on $Na_{0.5}Bi_{0.5}TiO_3$

Aurang Zeb[1,2] Saeed ullah Jan[1,2], Faith Bamiduro[1], David A. Hall[3] and Steven J. Milne[1]

[1] Advanced Engineering Materials, School of Chemical Engineering, University of Leeds, Leeds LS2 9JT, U.K.

[2]Department of Physics, Islamia College Peshawar, KP, Pakistan

[3] School of Materials, University of Manchester, Manchester, M13 9PL, U.K.

Abstract

Multiple ion substitutions to $Na_{0.5}Bi_{0.5}TiO_3$ give rise to favourable dielectric properties over the technologically important temperature range -55 °C to 300 °C. A relative permittivity, ε_r, = 1300 ± 15 % was recorded, with low loss tangent, $\tan\delta \leq 0.025$, for temperatures from 300°C to 0°C, increasing to 0.05 at -55 °C (1 kHz) in the targeted solid solution $(1-x)[0.85Na_{0.5}Bi_{0.5}TiO_3–0.15Ba_{0.8}Ca_{0.2}Ti_{1-y}Zr_yO_3]–xNaNbO_3$: x = 0.3, y= 0.2. The ε_r-T plots for $NaNbO_3$ contents x < 0.2 exhibited a frequency-dependent inflection below the temperature of a broad dielectric peak. Higher levels of niobate substitution resulted in a single peak with frequency dispersion, typical of a normal relaxor ferroelectric. Experimental trends in properties suggest that the dielectric inflection is the true relaxor dielectric peak and appears as an inflection due to overlap with an independent broad dielectric peak. Process-related cation and oxygen vacancies and their possible contributions to dielectric properties are discussed.

Keywords: Dielectrics; sodium bismuth titanate; high-temperature capacitor materials