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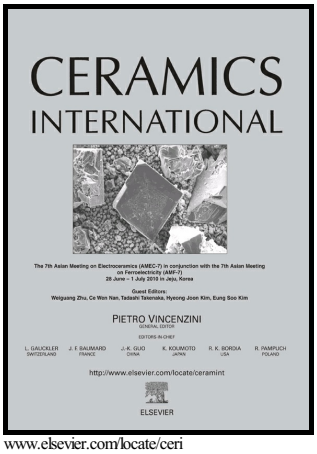

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Enhanced energy storage properties of BaO-K_2O-Nb_2O_5-SiO_2 glass ceramics obtained through microwave crystallization

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Abstract:

BaO-K_2O-Nb_2O_5-SiO_2 (BKNS) glass ceramics were prepared by microwave crystallization of transparent glass matrices and the effects of microwave treatment temperature on their dielectric performances, phase structure, microstructure and breakdown strength (BDS) were investigated systematically. X-ray diffraction results suggested that microwave treatment had no significant influence on the type of precipitated phases. The microstructure of the glass ceramics was remarkably optimized via microwave treatment. The dielectric constant and breakdown strength of microwave-treated samples were significantly improved as compared with conventional-heated samples at the same temperature. The maximum theoretical energy storage density of microwave-treatment samples at 750 ^oC reached 12.7 J/cm^3, which was larger than that of the conventional-heated samples (8.6 J/cm^3).

Keywords: Glass ceramics; Microwave treatment; Dielectric properties; Breakdown strength; Energy storage density.

1. Introduction:

High-performance dielectric materials are widely applied in power electronics, high-power microwave systems, and pulsed power systems [1, 2]. For linear dielectric materials, the theoretical energy storage density (W) can be achieved by the relative dielectric constant (ε_r) and applied electric field (E) based on the equation [3]:

$$W = \frac{1}{2}\varepsilon_0\varepsilon_r E^2 \quad (1)$$

where ε_0 is the vacuum dielectric constant. Dielectric ceramics are a kind of industrialized capacitor materials, which process many advantages such as high