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Effects of Crystallization Temperature on Phase Evolution and Energy Storage Properties of $BaO-Na_2O-Nb_2O_5-SiO_2-Al_2O_3$ Glass-Ceramics

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Highlights

► $BaO-Na_2O-Nb_2O_5-Al_2O_3-SiO_2$ glass ceramics were controllable crystallized at different temperatures and the energy storage properties were discussed.
► According to DSC analysis, the crystallization of this system is mainly determined by Si-O bond breaking at lower crystallization temperature and diffusion of Si^{4+} at higher temperature.
► $Ba_2NaNb_5O_{15}$ phase is dominant in all samples with $BaAl_2Si_2O_8$ and $AlNbO_4$ increasing at high temperature, as shown in XRD patterns.
► The sample heated at 800 ^oC exhibits the highest energy storage density of 16.6 J/cm^3 with remarkable breakdown strength of 2322 kV/cm.
► The empirical power-law dependence of breakdown strength on thickness is confirmed in this system, with n = 0.21 indicating the electron-phonon $\left(E_b \propto d^{-n}\right)$ interactions effect.

Abstract: Barium sodium niobate (BNN) glass ceramics were successfully fabricated with controllable crystallization by technology for heating processing and the effects of crystallization temperatures on phase evolution, microstructure, dielectric properties and breakdown strength were investigated systematically. In addition, the empirical power-law dependence of breakdown strength on thickness ($E_b \propto d^{-n}$) was confirmed in BNN glass-ceramic system with an exponent n of 0.21. Based on the