Achieving ultra-high energy storage performance in $(Bi_{0.5}Na_{0.5})_{0.7}Sr_{0.3}TiO_3$-based relaxor ferroelectrics

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2. Experimental procedures

(1-*x*)$(Bi_{0.5}Na_{0.5})_{0.7}Sr_{0.3}TiO_3$-*x*$Sm(Mg_{2/3}Nb_{1/3})O_3$($x$ = 0.08, 0.12, 0.16, and 0.20), referred to as (1-*x*)BNST-*x*SMN, was prepared by the conventional solid state reaction method. The BNST powders were prepared by using Bi_2O_3(99.00 %), Na_2CO_3(99.80 %), $SrCO_3$(99.80 %), TiO_2(99.80 %) mixed in a certain ratio, Sm_2O_3(99.99 %), MgO(98.50 %), Nb_2O_5(99.50 %) were mixed in a certain ratio to make SMN powder. These powders were mixed with pickaxe balls and anhydrous ethanol for 4 hours, and then drying. The BNST powder and SMN powder were mixed according to certain ratio, mixed for the second ball milling. The resulting powder is pelletized into 60~120 mesh particles by using 8 % PVA glue, and then the particles are pressed into a wafer with a diameter of 8mm, the thickness of about 1.5mm, and finally pressed into the piece in a muffle furnace at 1 °C/min up to 550 °C, holding time of 4 hours to row out the PVA glue. The samples were put in the precursor powder of the same composition and sintered at 1240 °C for 2 hours. Finally, grinding samples to about 0.1mm and coating a silver paste with 2mm in diameter, the ferroelectric properties were tested after drying.

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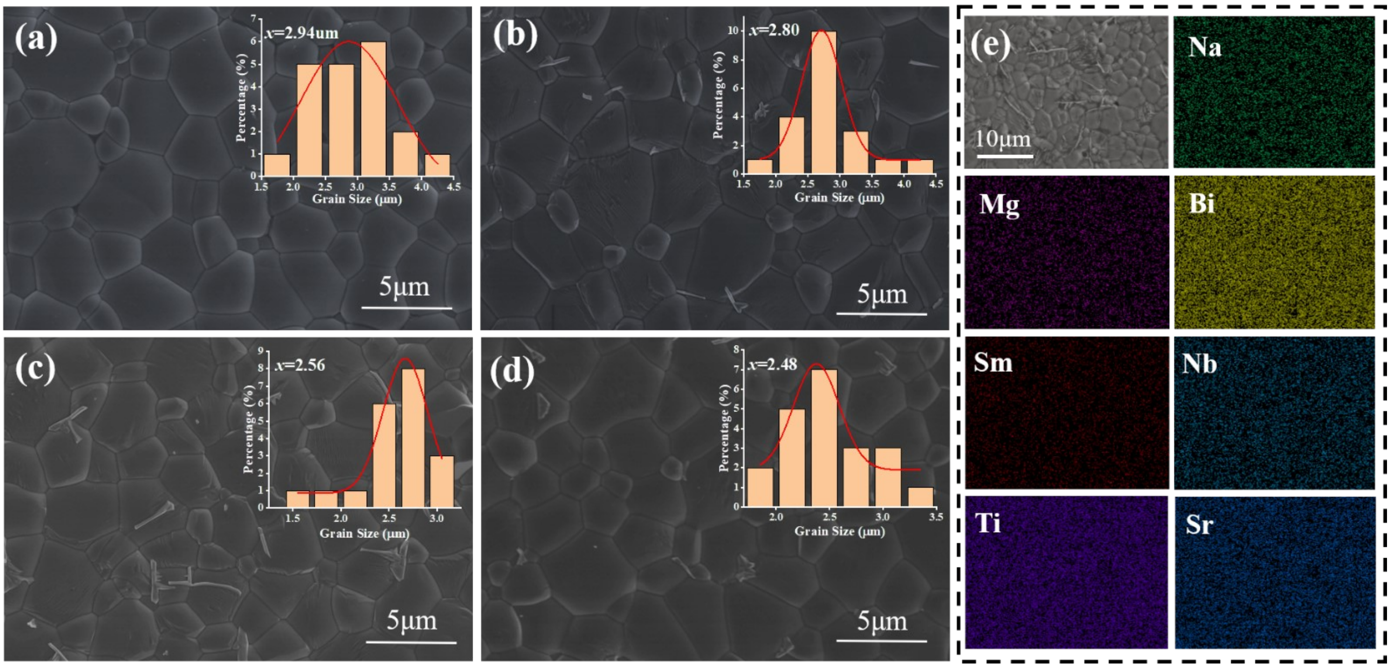

Figure S1 SEM images (a - d) of the (1-*x*)BNST-*x*SMN (*x* = 0.08, 0.12, 0.16, and 0.20) ceramics. (e) Elemental mapping of the 0.12SMN ceramic.

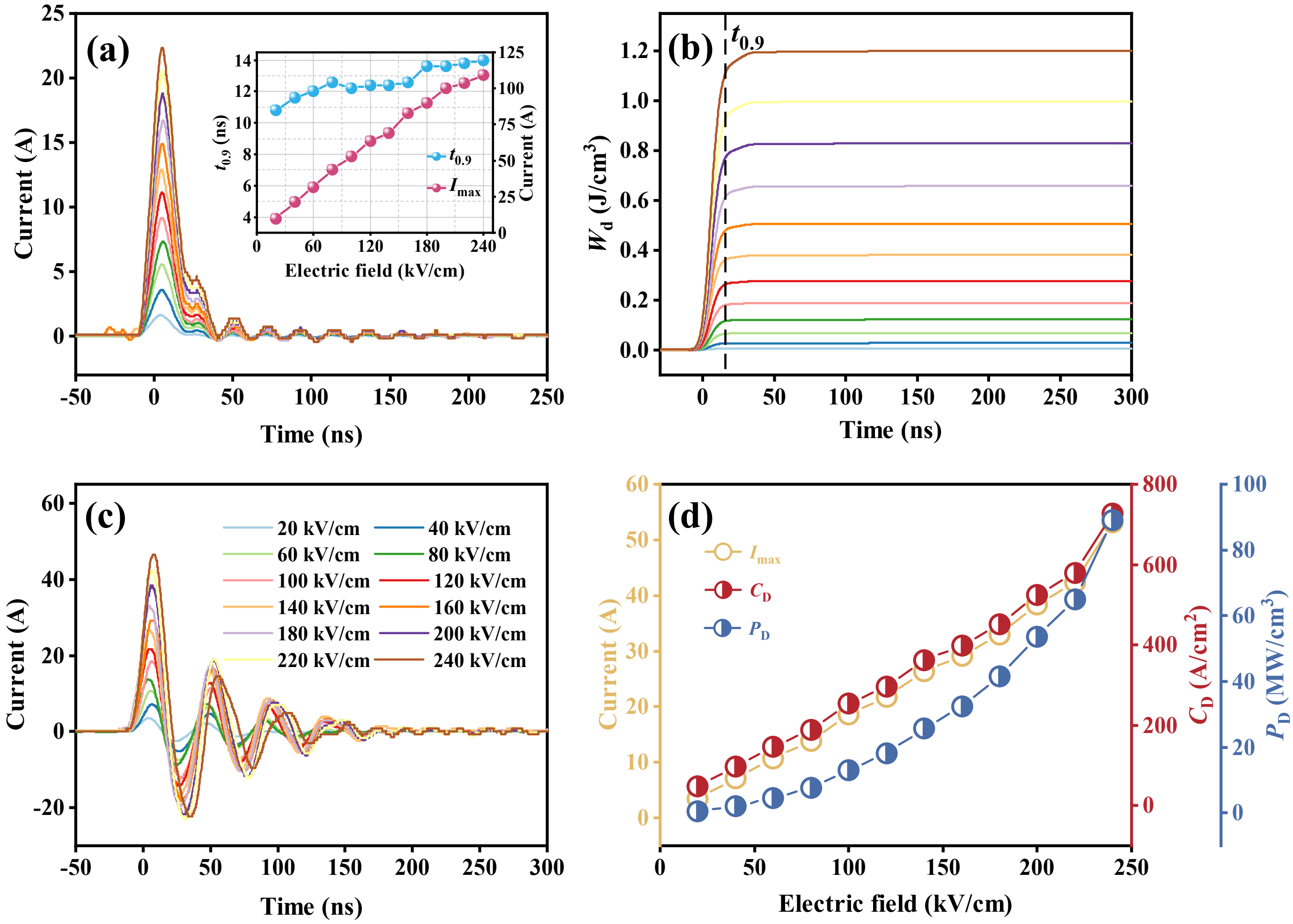

Figure S2 (a) The overdamped charge-discharge results and $t_{0.9}$, I_{max} of *x*SMN ceramics under different electric fields at room temperature. (b) Time-dependence of pulsed discharge energy density of *x*SMN ceramics. (c) Underdamped discharge waveform of 0.12SMN ceramic at room temperature. (d) Changes of I_{max}, C_D, and P_D at room temperature.

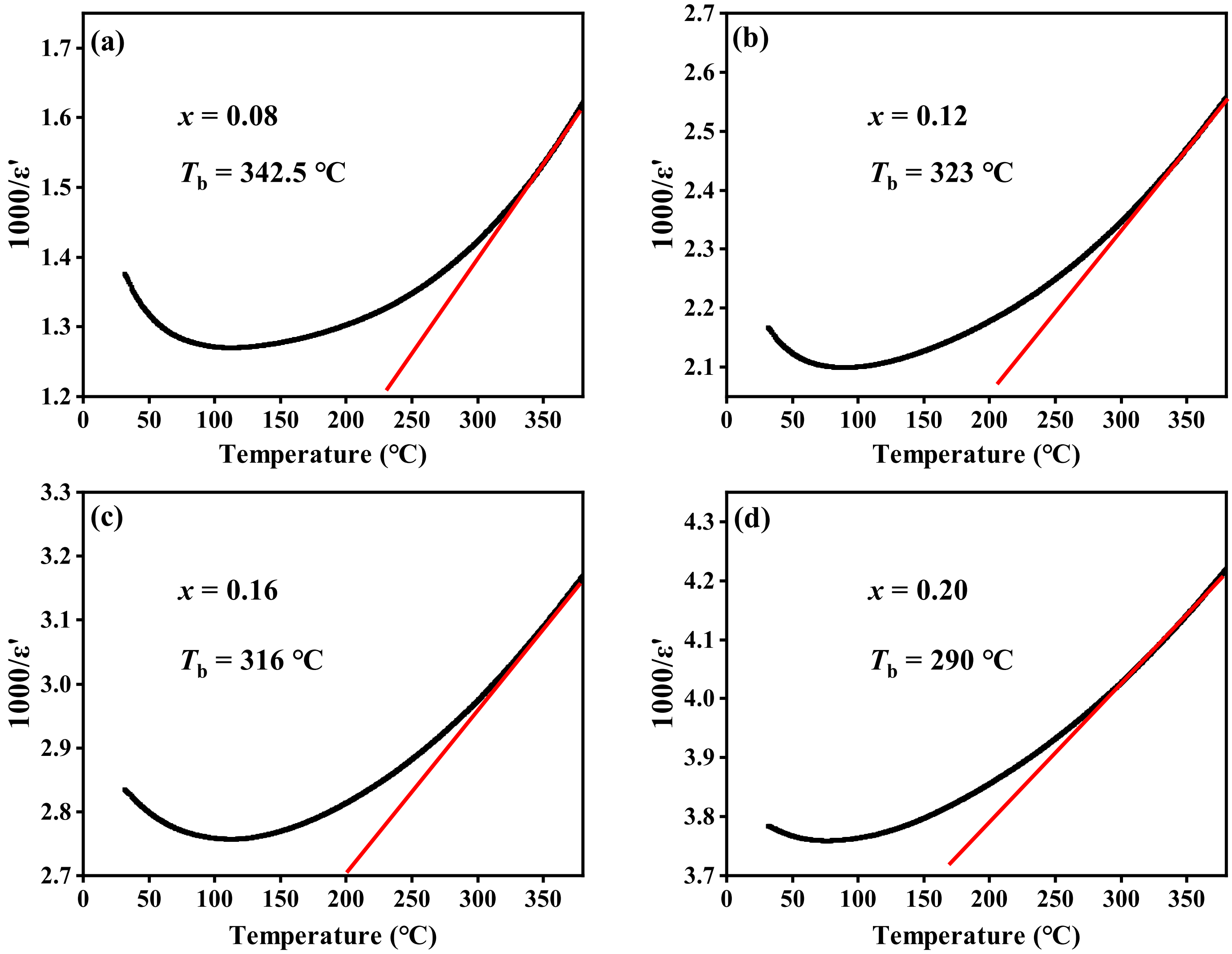

Figure S3 The burn temperature fitting curve of (1-x)BNST-xSMN (x = 0.08, 0.12, 0.16, and 0.20) ceramics.

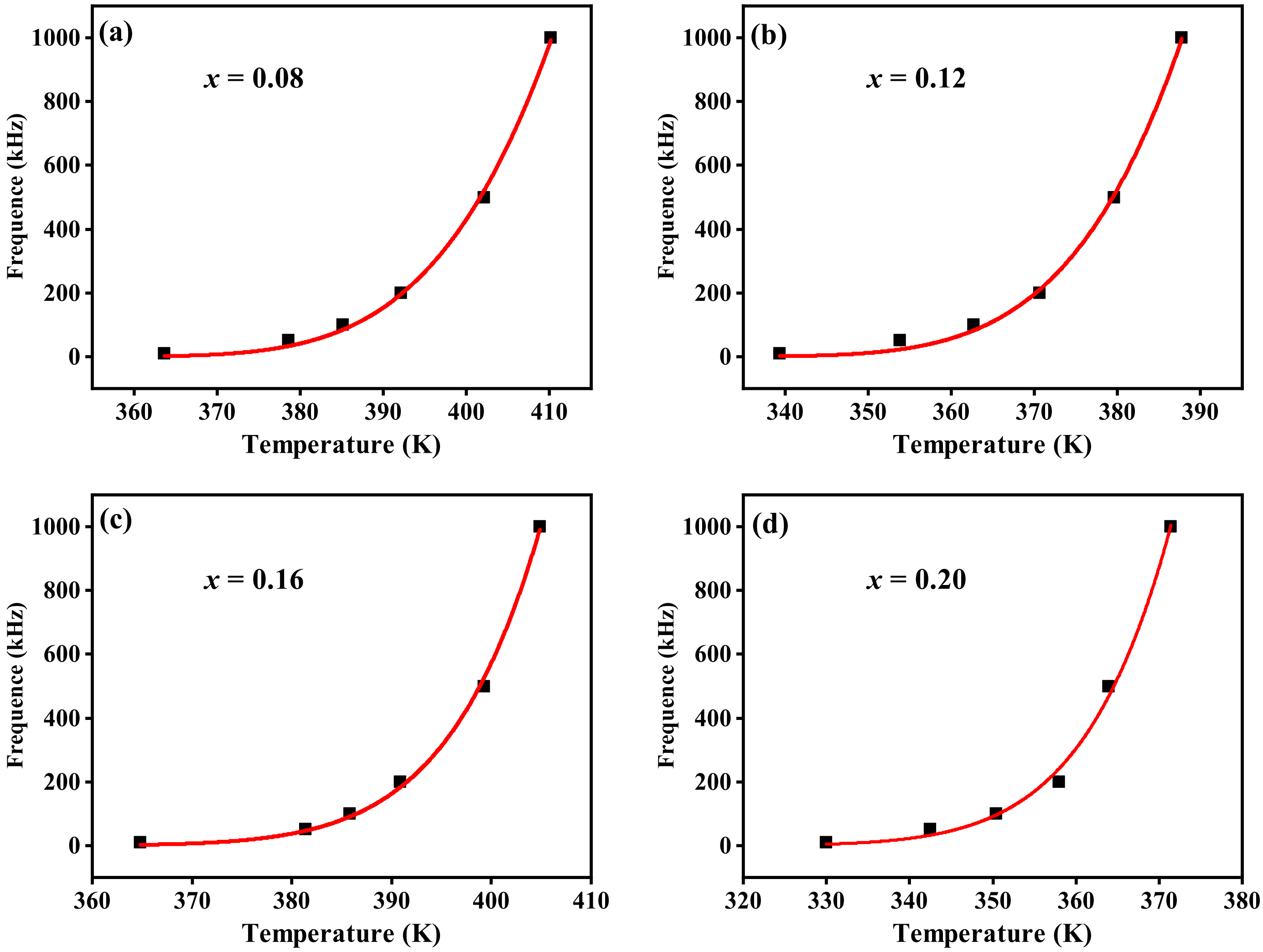

Figure S4 The frozen temperature fitting curve of (1-x)BNST-xSMN (x = 0.08, 0.12, 0.16, and 0.20) ceramics