Supporting Information

Improved energy storage properties achieved in $NaNbO_3$-based relaxor antiferroelectric ceramics via anti-parallel polar nanoregions design

Zhentao Wang [a], Da Li [a], Wenyuan Liu [b], Xu Liang [b], Weichen Zhao [a], Jinnan Liu [a], Jiajia Ren [a], Tao Zhou [d], Diming Xu [a], Wenfeng Liu [c], and Di Zhou [a*]

[a] Electronic Materials Research Laboratory, Key Laboratory of the Ministry of Education & International Center for Dielectric Research, School of Electronic and Information Engineering, Xi'an Jiaotong University, Xi'an 710049, China

[b] State Key Laboratory for Strength and Vibration of Mechanical Structures, School of Aerospace Engineering, Xi'an Jiaotong University, Xi'an 710049, China

[c] State Key Laboratory of Electrical Insulation and Power Equipment, Xi'an Jiaotong University, Xi'an 710049, China

[d] School of Electronic and Information Engineering, Hangzhou Dianzi University, Hangzhou 310018, China

[*] Corresponding author: Di Zhou; E-mail address: zhoudi1220@xjtu.edu.cn;

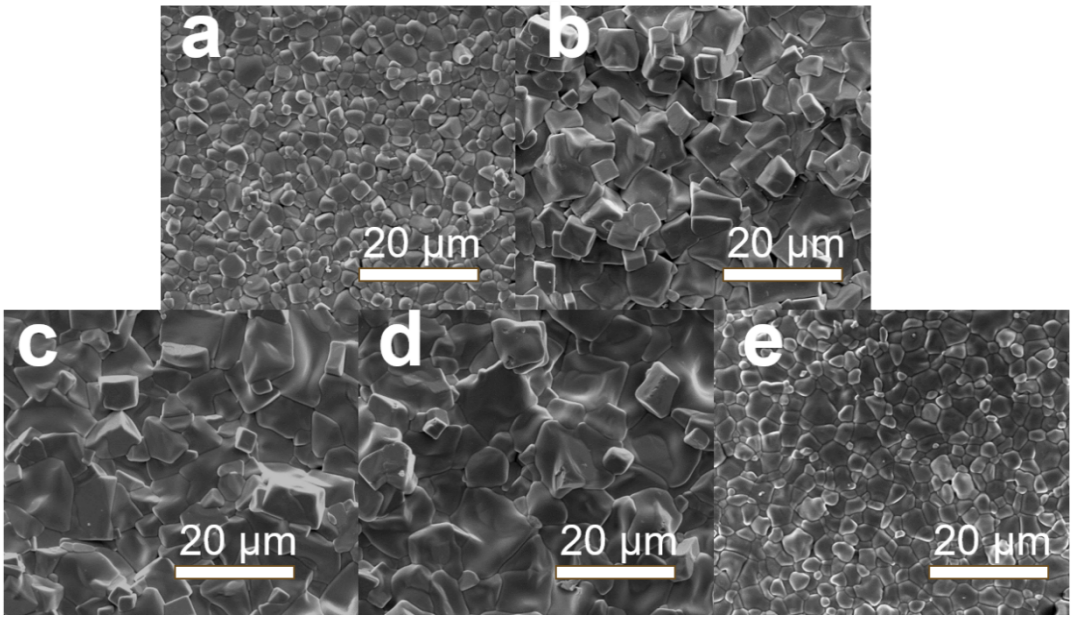

Fig. S1 SEM micrographs of NN-BZH ceramics. a) x = 0.05, b) x = 0.10, c) x = 0.15, d) x = 0.20, e) x = 0.15 (RRP).

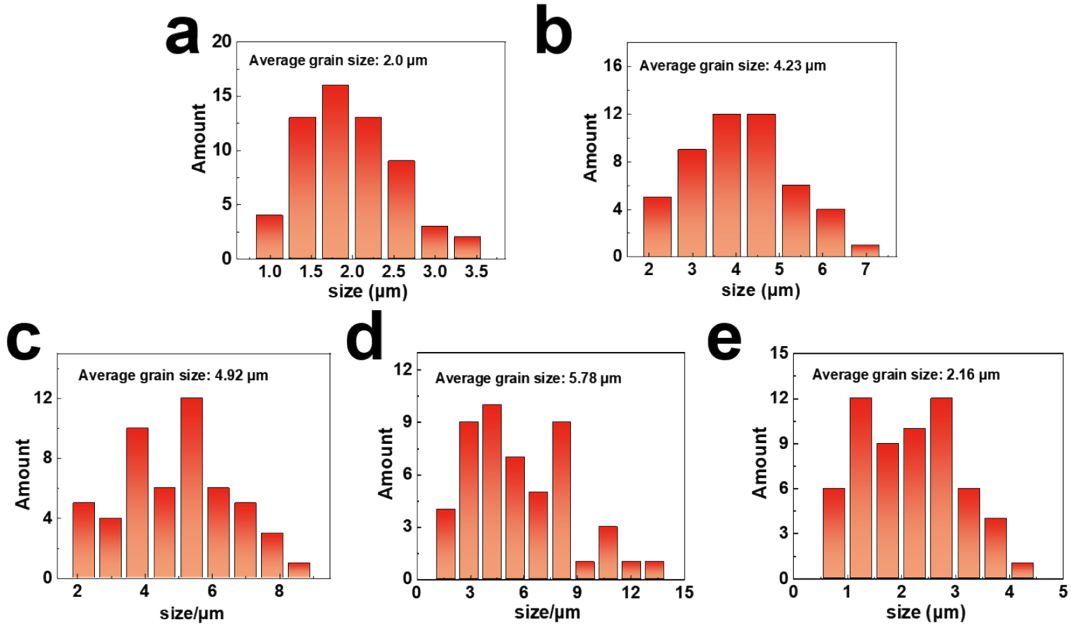

Fig. S2 The distribution of grain size of NN-BZH ceramics. a) x = 0.05, b) x = 0.10, c) x = 0.15, d) x = 0.20, e) x = 0.15 (RRP).

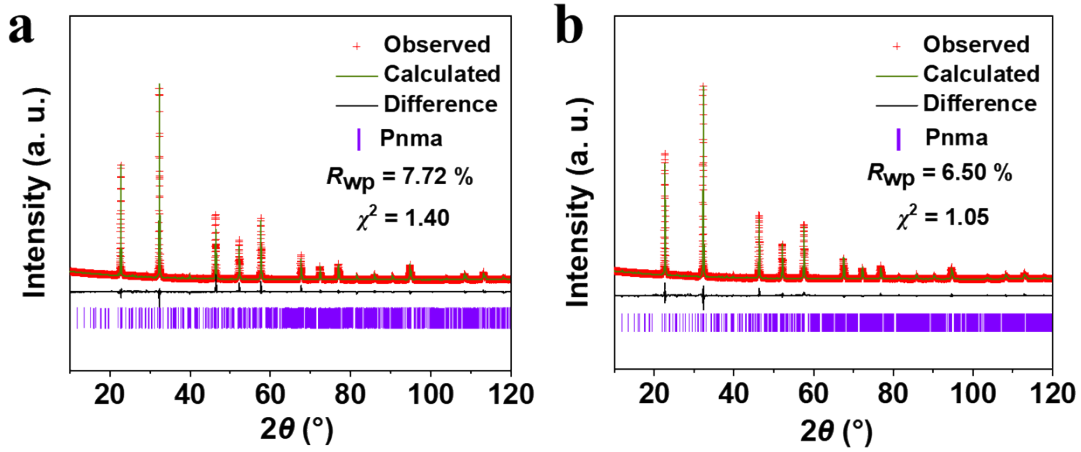

Fig. S3 The Rietveld refinement of XRD data for the a) x = 0.10, b) x = 0.20 ceramics.

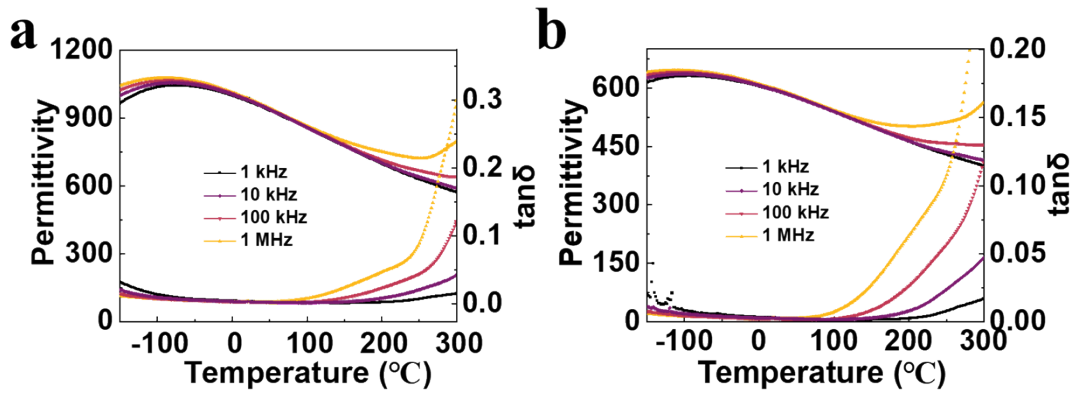

Fig. S4 Permittivity and dielectric loss as a function of temperature at various frequencies for a) x = 0.10, b) x = 0.20 ceramics.

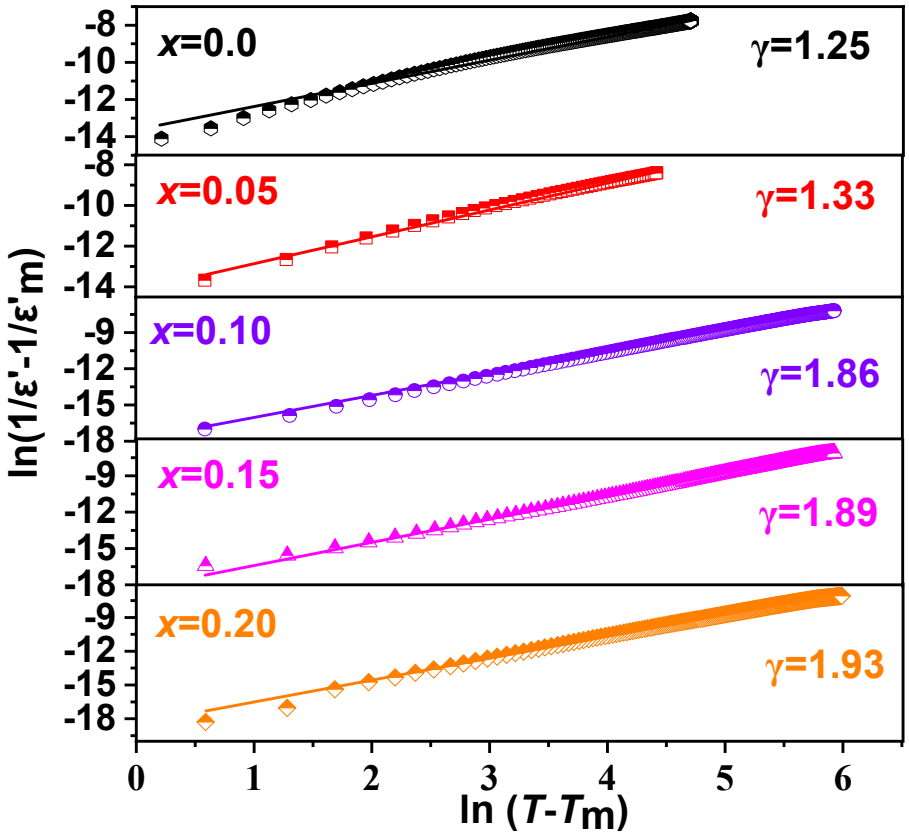

Fig. S5 ln ($1/\varepsilon$'-$1/\varepsilon_m$') versus ln (T-T_m) for (1-x)NN-xBZH ceramics.

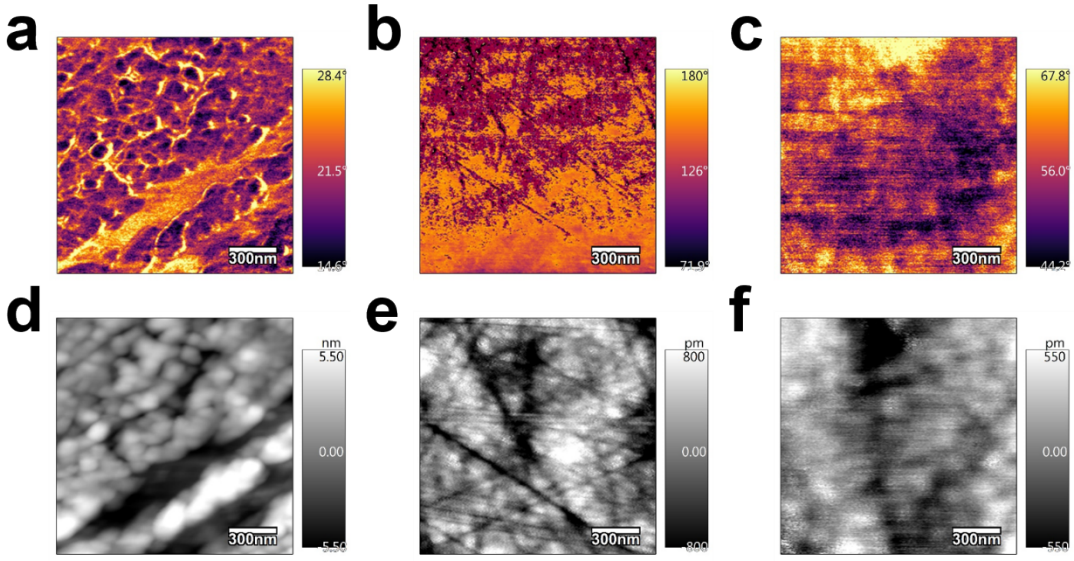

Fig. S6 Out-of-plane PFM phase and topography images of a) and d) NN, b) and e) x = 0.05, c) and f) x = 0.15.

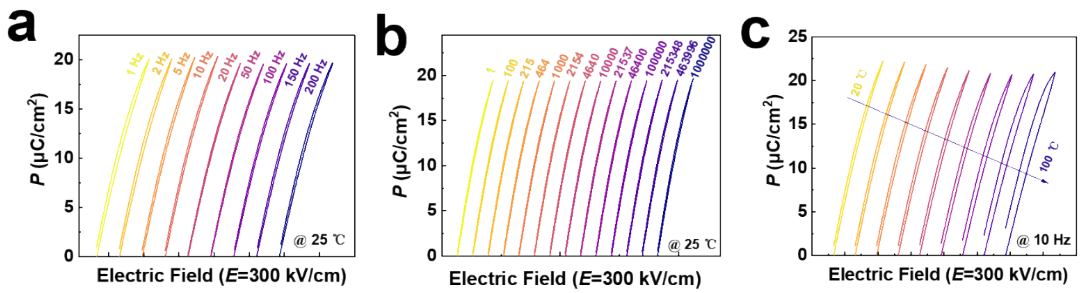

Fig. S7 a) Frequency-dependence (1-200 Hz), b) cycle-dependence (1-10^6) and (c) temperature-dependence (20–100 ℃) *P*-*E* hysteresis loop for $x = 0.15$ (RRP) ceramics under 300 kV/cm.

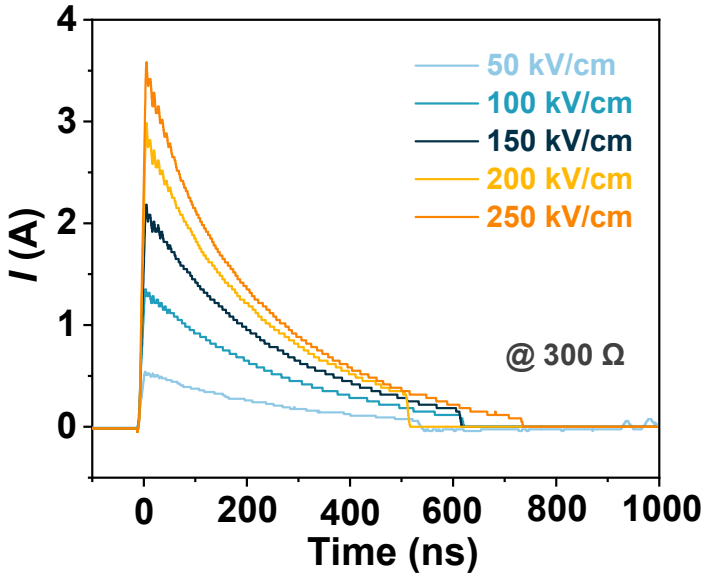

Fig. S8 Over-damped discharging waveforms of discharge energy density at various electric field for $x = 0.15$ (RRP).