SUPPLEMENTARY INFORMATION

for

Stabilization of the first-order phase transition character and Enhancement of the Electrocaloric Effect by NBT substitution in $BaTiO_3$ ceramics

Merve Karakaya[a], İrem Gürbüz[a,b], Lovro Fulanovic[c], Umut Adem[a]

[a]Department of Materials Science and Engineering, İzmir Institute of Technology, Urla, 35430, İzmir Turkey

[b]Department of Chemistry, Aix-Marseille University, 52 Avenue Escadrille Normandie Niemen, 13013, Marseille, France.

[c]Nonmetallic Inorganic Materials, Department of Materials and Earth Sciences, Technical University of Darmstadt, Peter-Grünberg-Straße 2, 64287 Darmstadt, Germany

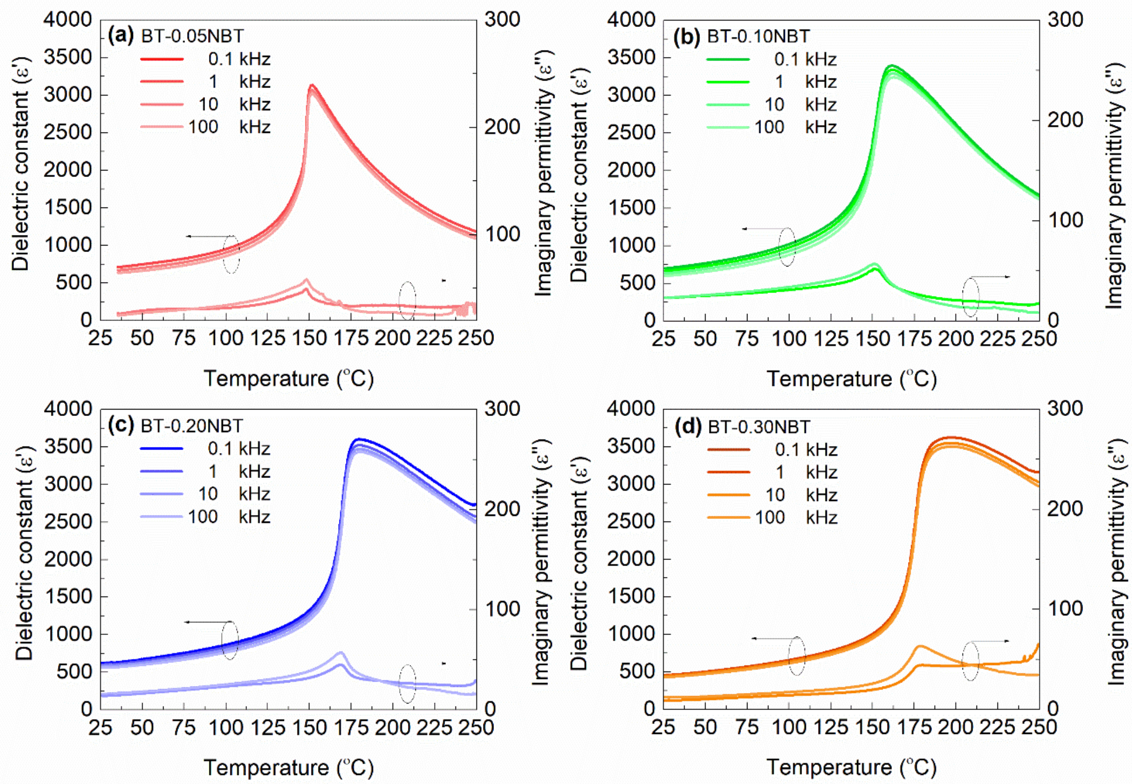

Fig. S1. Temperature dependence of the dielectric constant and imaginary permittivity at 0.1, 1, 10 and 100 kHz of (1-x)$BaTiO_3$-x$Na_{0.5}Bi_{0.5}TiO_3$ samples: (a) x = 0.05, (b) x = 0.10, (c) x = 0.20, (d) x = 0.30.

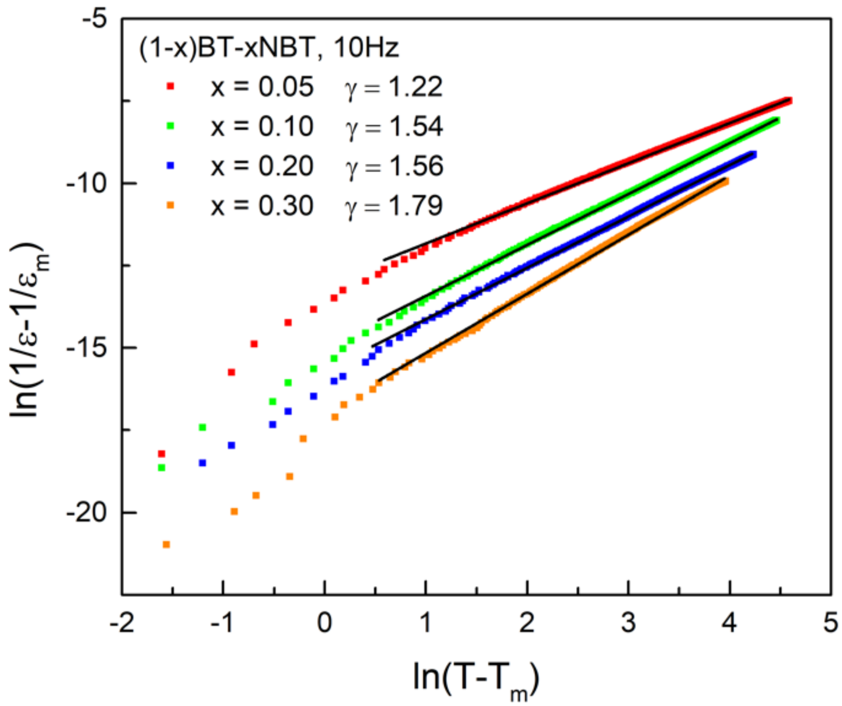

Fig. S2. The plot of $\ln(1/\varepsilon-1/\varepsilon_m)$ as a function of $\ln(T-T_m)$ for all compositions, showing γ coefficients and linear fits.

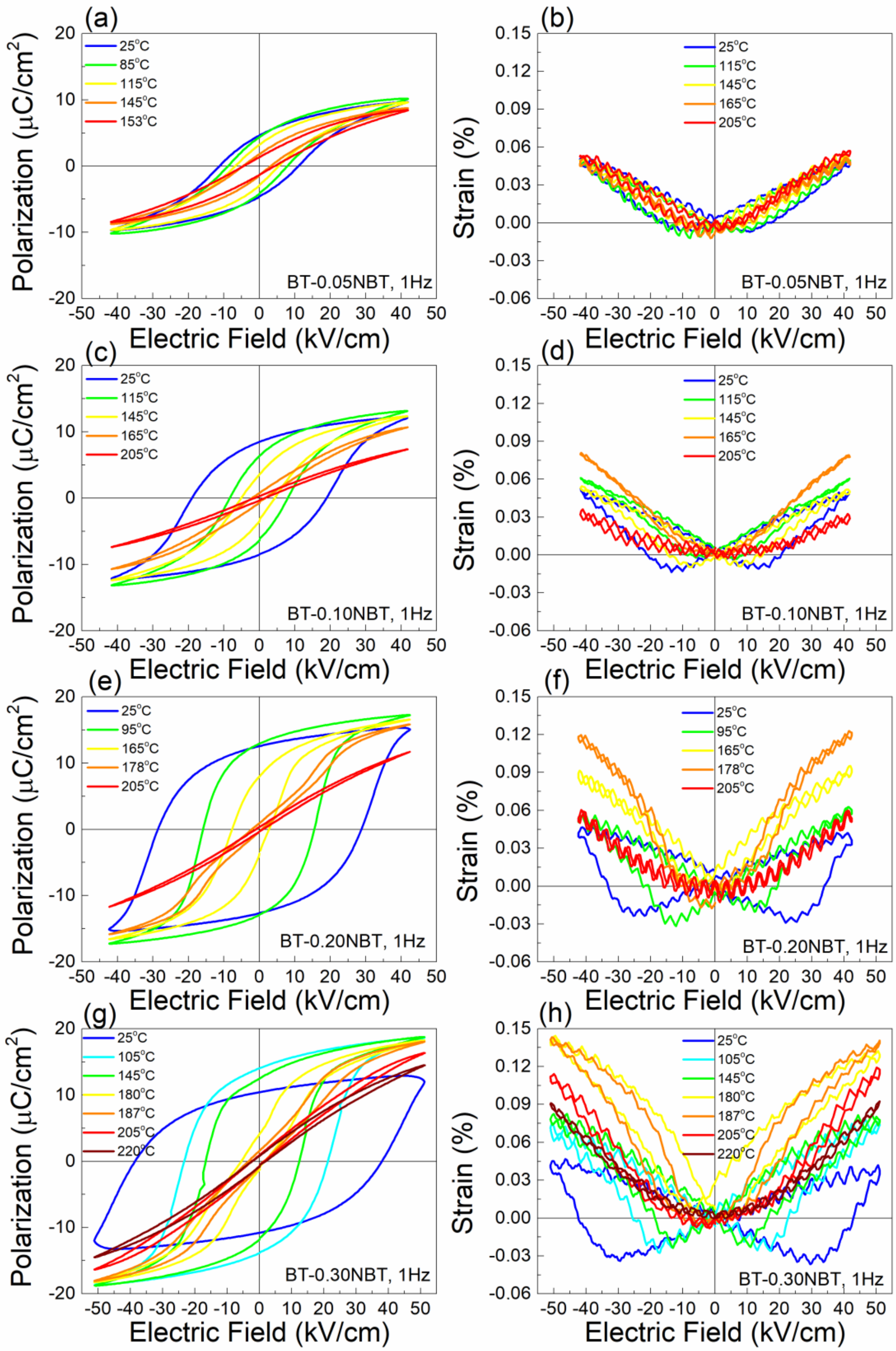

Fig. S3. Temperature dependent P(E) hysteresis loops and strain-electric field curves at selected temperatures. (a, b) x = 0.05, (c, d) x = 0.10, (e, f) x = 0.20, (g, h) x = 0.30.

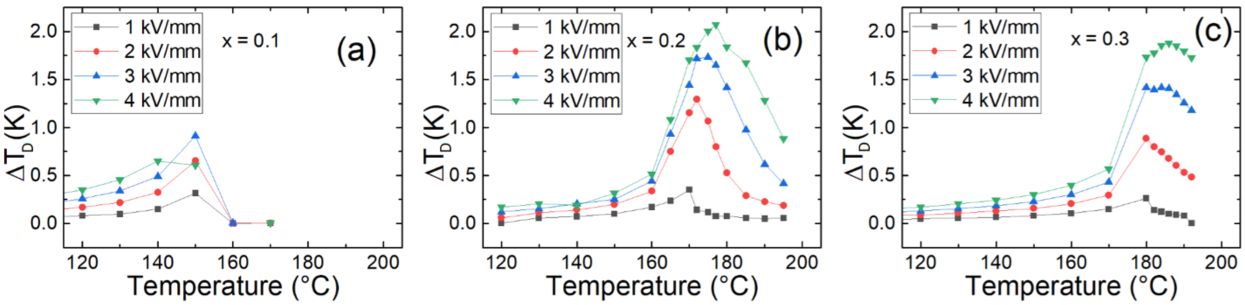

Fig. S4. Temperature and electric field dependence of directly measured ΔT_D for (a) x = 0.1, (b) x = 0.2 and (c) x = 0.3 samples.

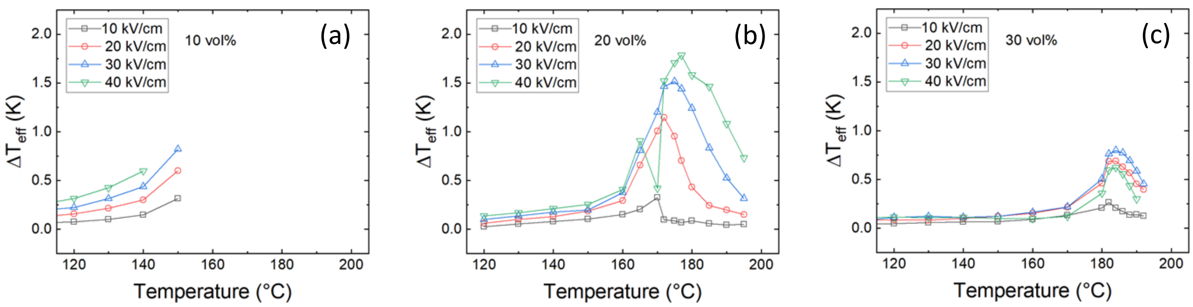

Fig. S5. Temperature and electric field dependence of directly measured effective EC cooling ΔT_{eff} for (a) x = 0.1, (b) x = 0.2 and (c) x =0.3 samples. $\Delta T_{eff} = \Delta T_D - \Delta T_{JH}$

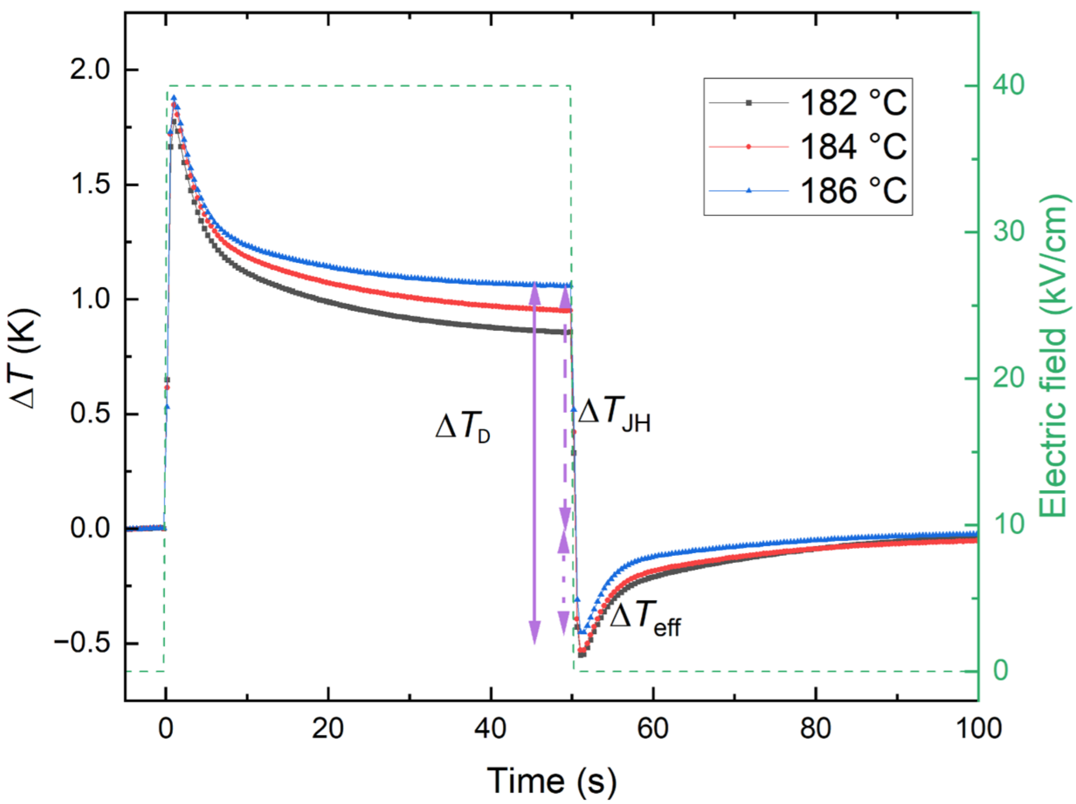

Fig. S6. Directly measured *ΔT* for 0.7BT-0.3NBT sample close to the dielectric maximum temperature as a function of time as the electric field was turned on and off. ΔT_D is the sum of the maximum effective EC cooling (ΔT_{eff}) and the Joule heating (ΔT_{JH}).

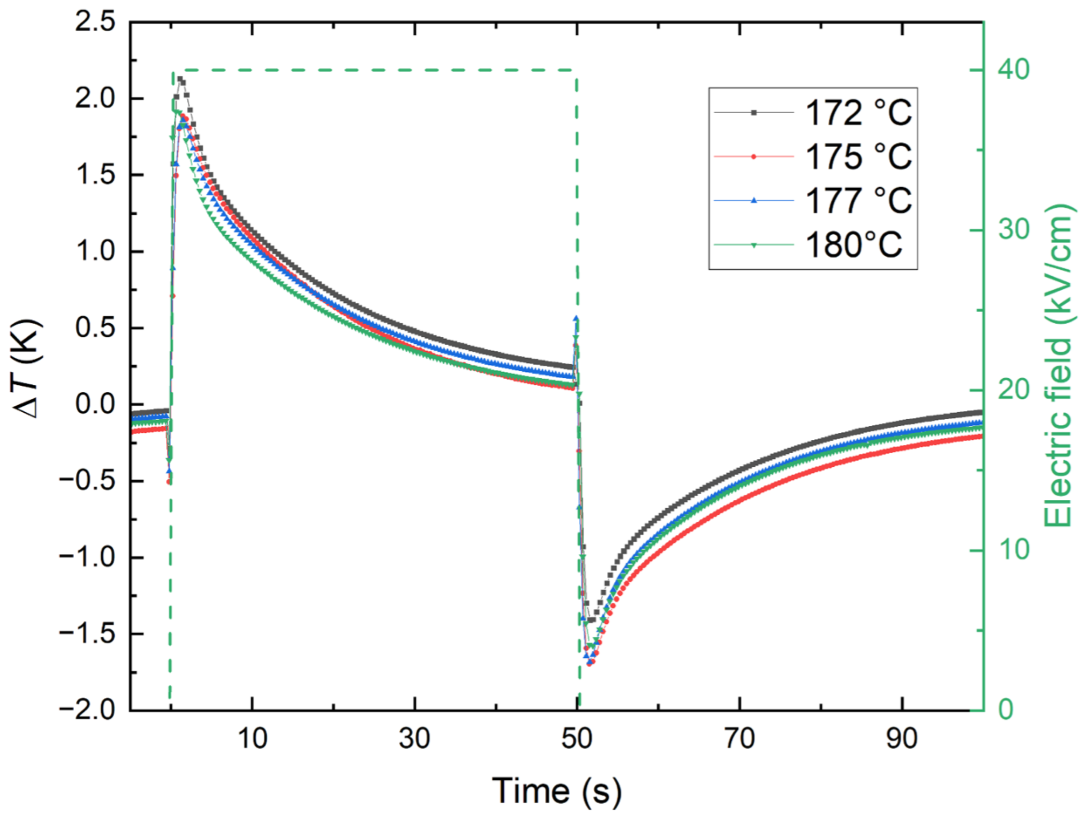

Fig. S7. Directly measured *ΔT* for 0.8BT-0.2NBT sample close to the dielectric maximum temperature as a function of time as the electric field was turned on and off.

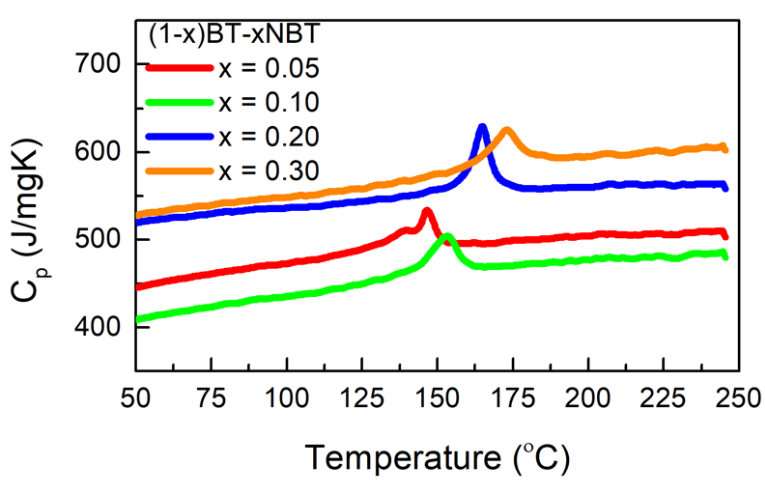

Fig. S8. Temperature dependence of specific heat of (1-x)$BaTiO_3$-x$Na_{0.5}Bi_{0.5}TiO_3$ samples.

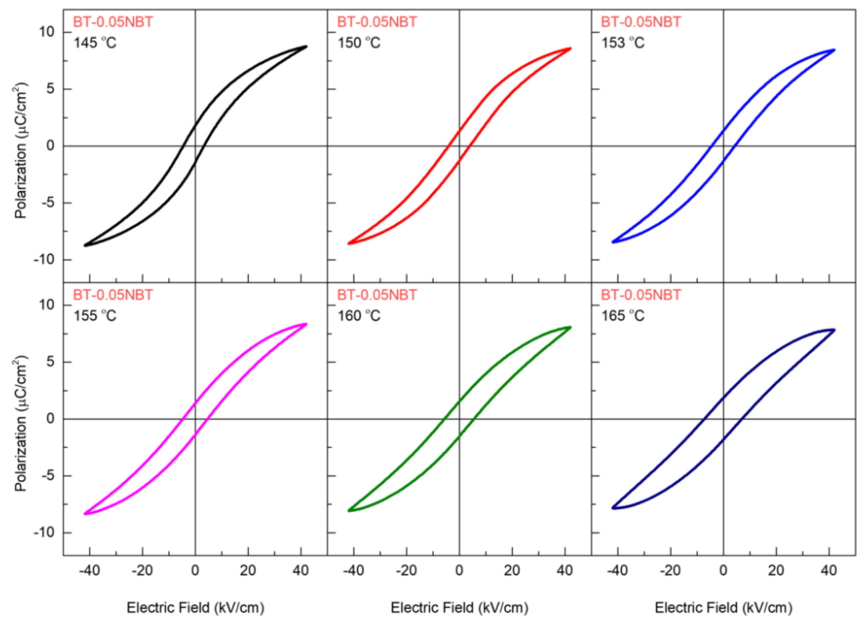

Fig. S9. P(E) hysteresis loops of 0.95BT-0.05NBT at and slightly above T_C.

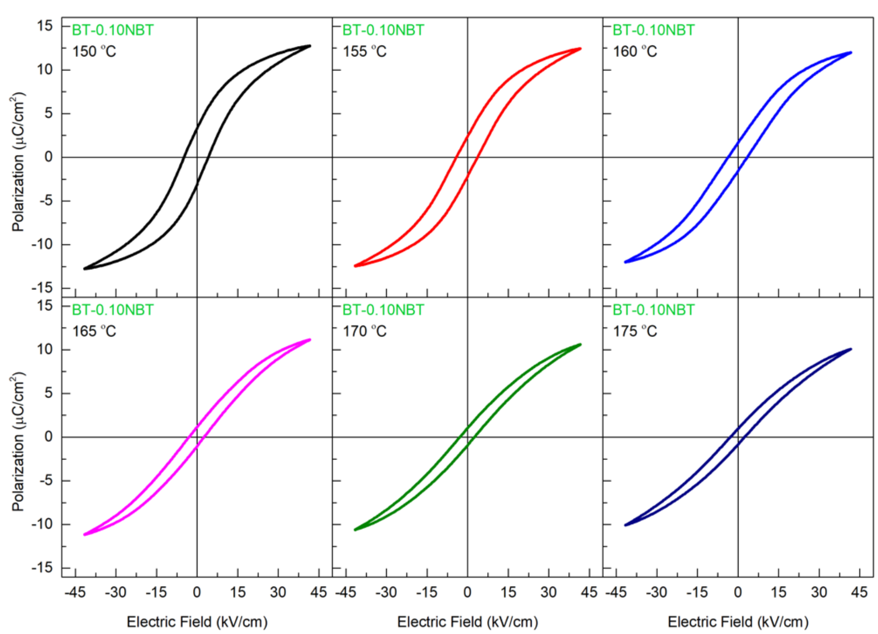

Fig. S10. P(E) hysteresis loops of 0.9BT-0.1NBT at and slightly above T_C.

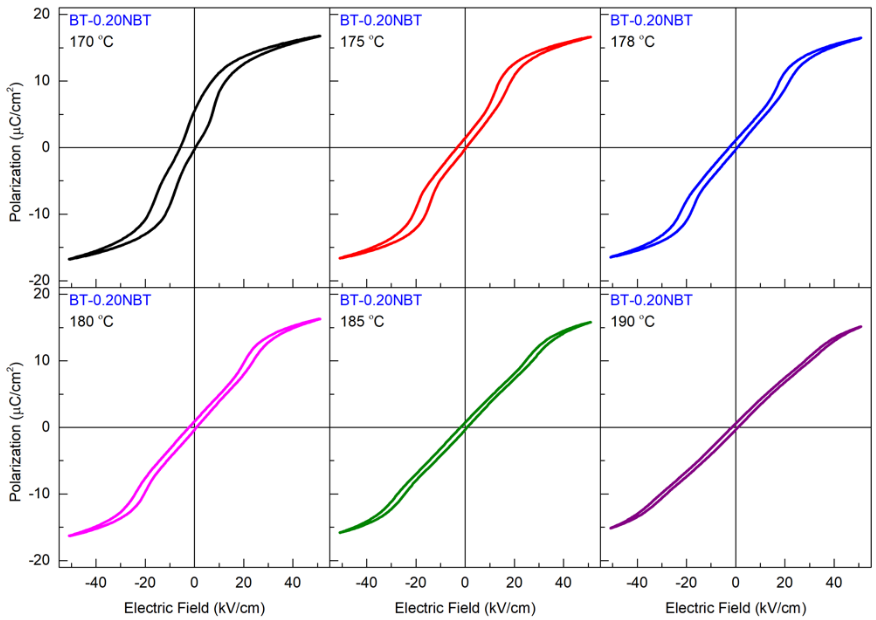

Fig. S11. P(E) hysteresis loops of 0.8BT-0.2NBT at and slightly above T_C.

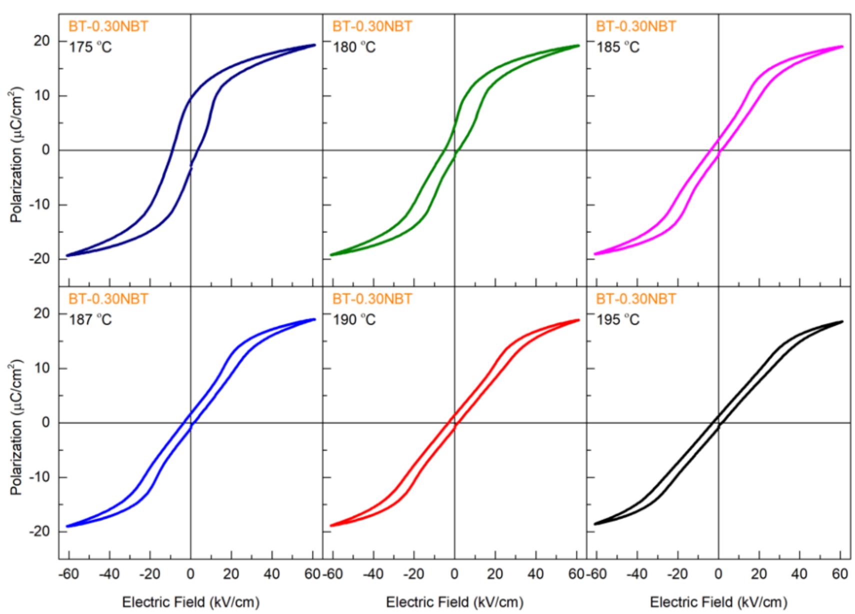

Fig. S12. P(E) hysteresis loops of 0.7BT-0.3NBT at and slightly above T_C.