Supporting Information (SI)

Upshift of Phase Transition Temperature in Nanostructured $PbTiO_3$ Thick Film for High Temperature Applications

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S1. Photo of pure $PbTiO_3$ ceramics sintered at 900 ^oC for 2 hours. Even though the sintered density is very low as ~ 80% of theoretical, large visible macro/micro cracks can be seen. The cracks formed due to a large volume change at the Tc.

Figure S1. Photo of pure $PbTiO_3$ ceramic sintered at 900 ^oC for 2 hours.

S2. Surface SEM images of $PbTiO_3$ film annealed at 700 ^oC for 1 hour. These can confirm the soundness of the film in terms of density, cracks, delaminations, and etc.

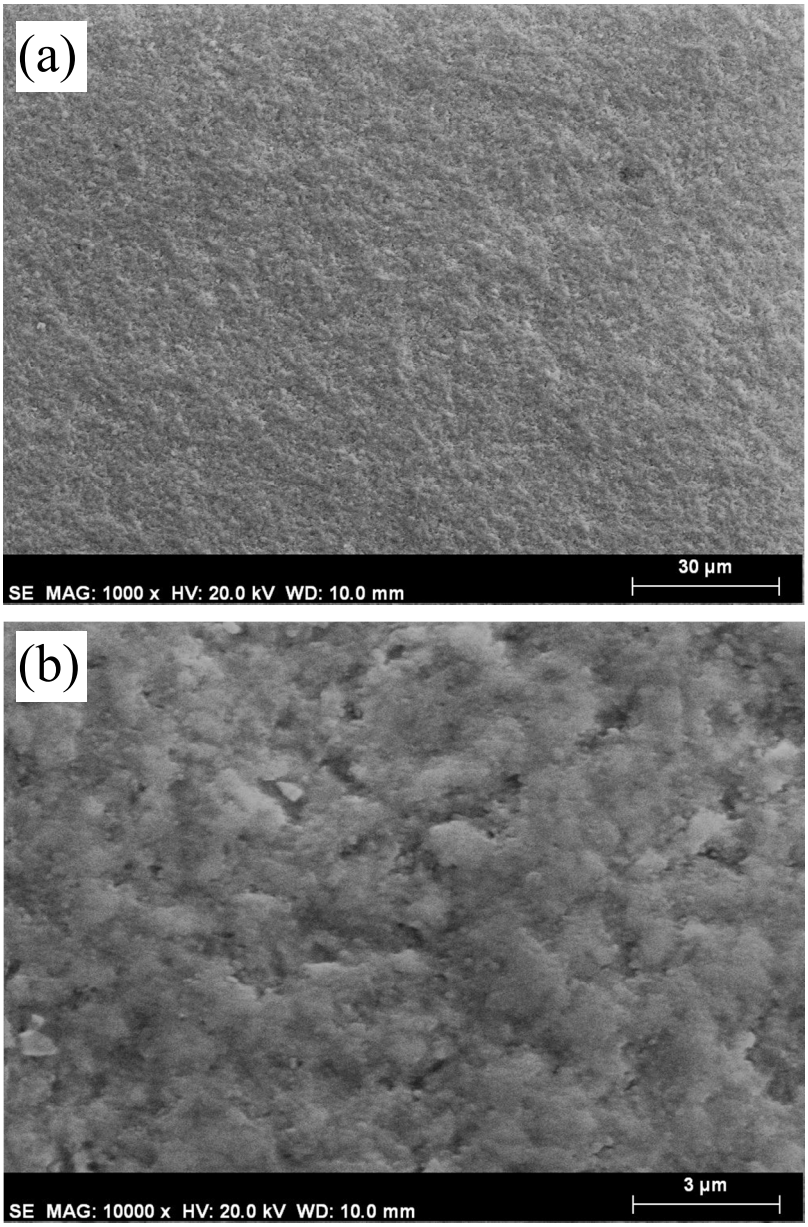

Figure S2. Surface SEM images of $PbTiO_3$ film annealed at 700 ^oC for 1 hour

S3. Photo and optical micrograph of $PbTiO_3$ film annealed at 700 ^oC for 1 hour. These also can confirm the soundness of the film in terms of density, cracks, delaminations, and etc.

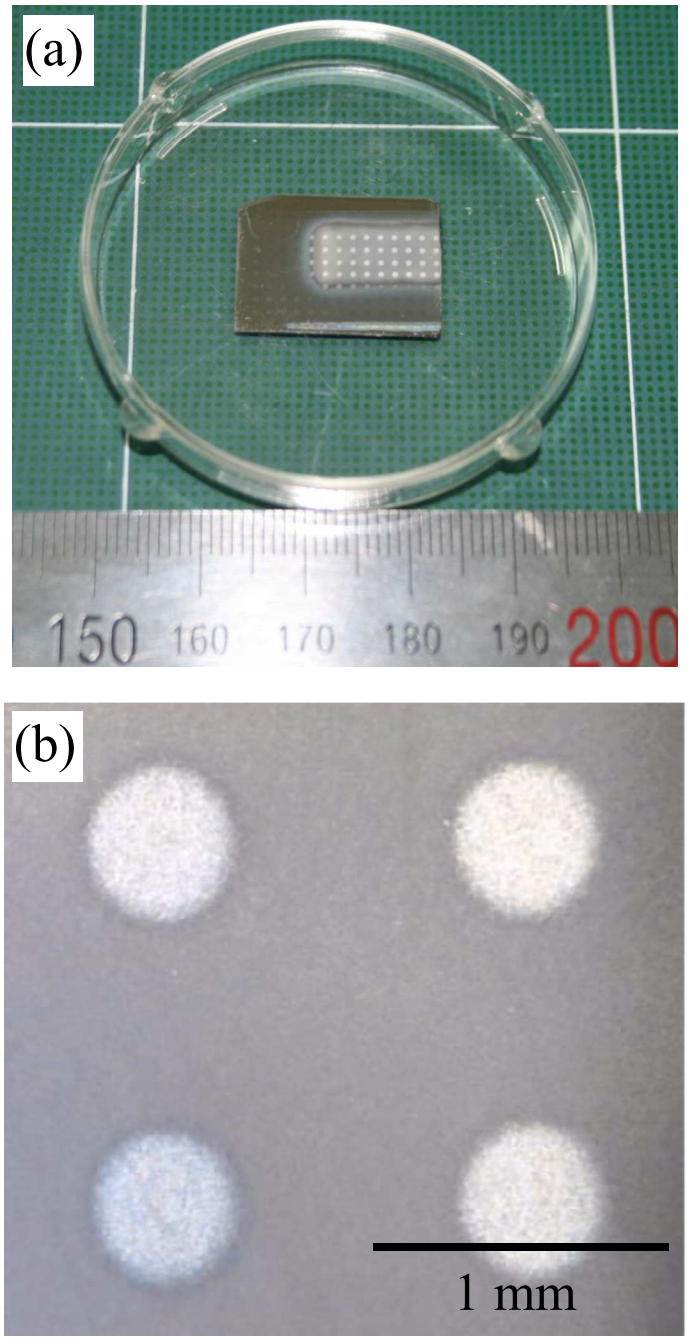

Figure S3. (a) Photo and (b) optical micrograph of $PbTiO_3$ film annealed at 700 ^oC for 1 hour.

S4. $d_{33,eff}$ measurement data from single beam LDV

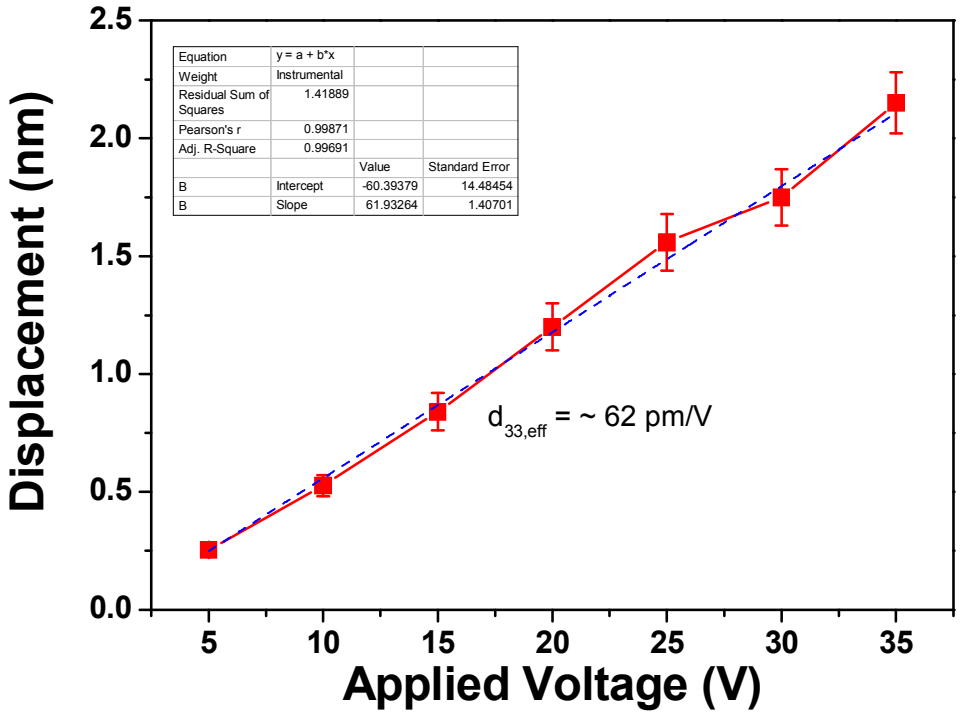

Figure S4. $d_{33,eff}$ measurement data from single beam LDV

S5. Animation of piezo-response deformation at 5.7, 11, and 17 V_{rms}. Below are captured images of animation at 5.7 V_{rms}.

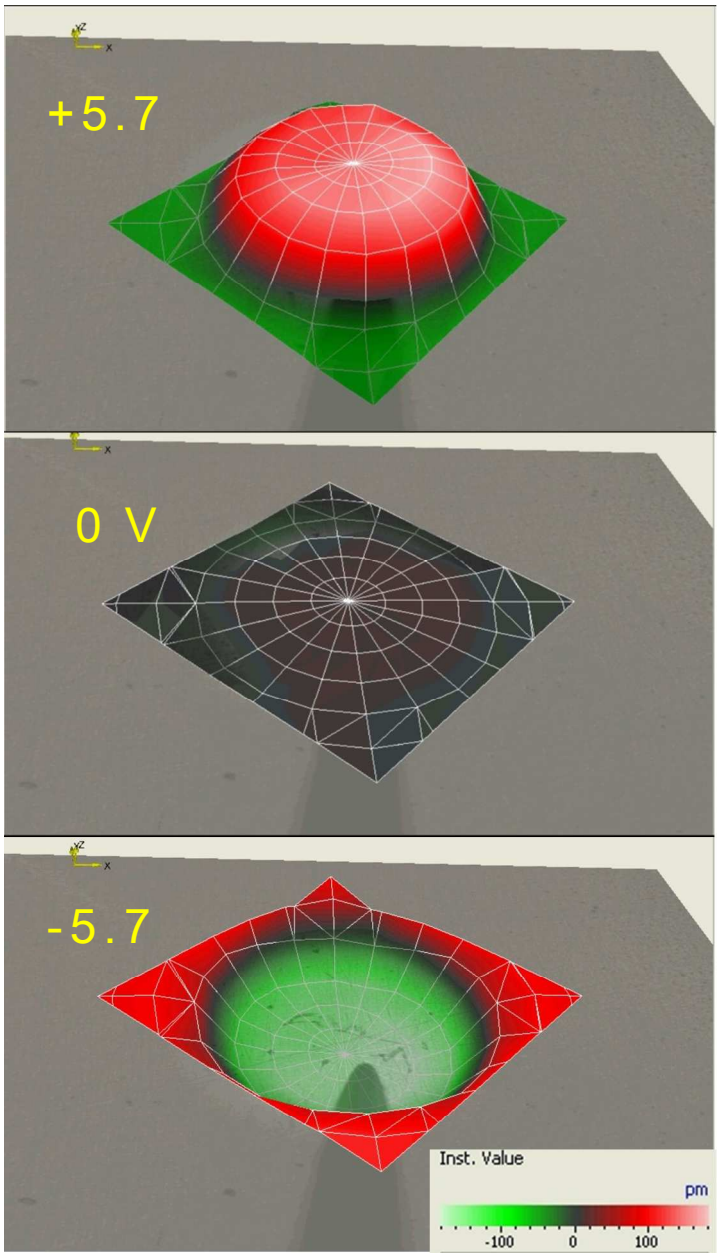

Figure S5. Captured images of piezo-response deformation monitored at 5.7 V_{rms}.

S6. Plot of inverse dielectric susceptibility as a function of temperature to confirm the phase transition temperature.

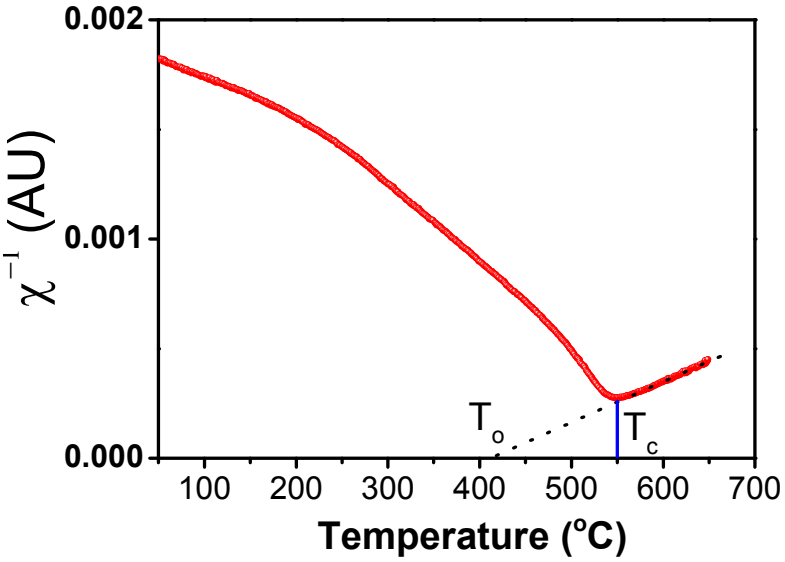

Figure S6. Inverse dielectric susceptibility of $PbTiO_3$ film annealed at 700 ^oC for 1 hour as a function of temperature