Supplementary Information

Taper $PbZr_{0.2}Ti_{0.8}O_3$ Nanowire Arrays: From Controlled Growth by Pulsed Laser Deposition to Piezopotential Measurements

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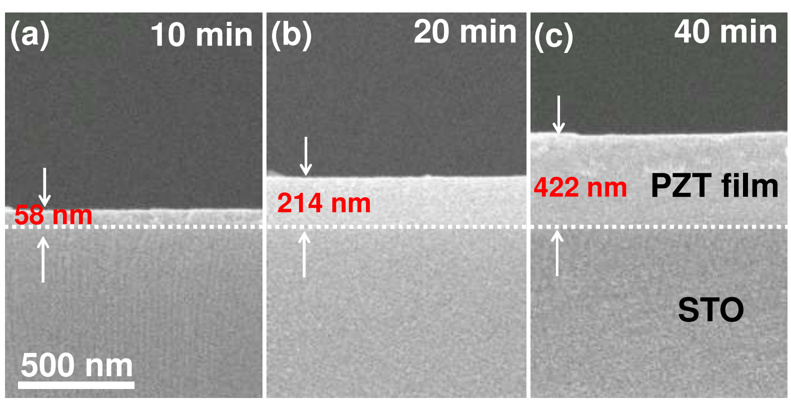

Figure S1 SEM images of the PZT thin film grown at 700 °C with the oxygen pressure of 400 mTorr at different growth time from (a) 10 min, (b) 20 min, and (c) 40 min, respectively.

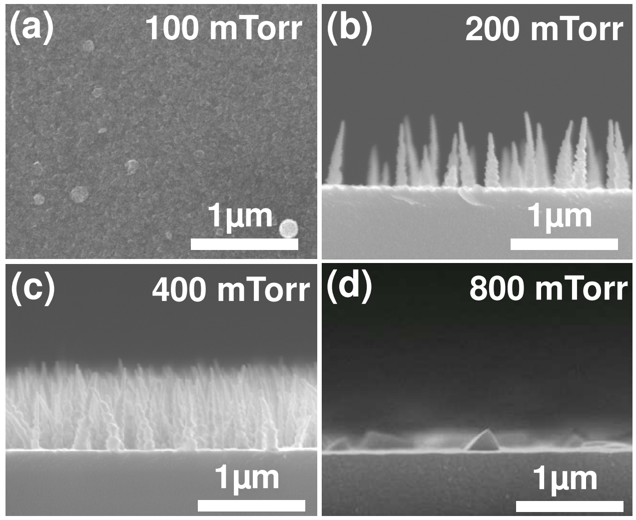

Figure S2 SEM images of PZT NWAs grown at the substrate temperature of 750 ^{o}C for 20 min with oxygen pressures varied from (a) 100 mTorr, (b) 200 mTorr, (c) 400 mTorr, and (d) 800 mTorr, respectively.

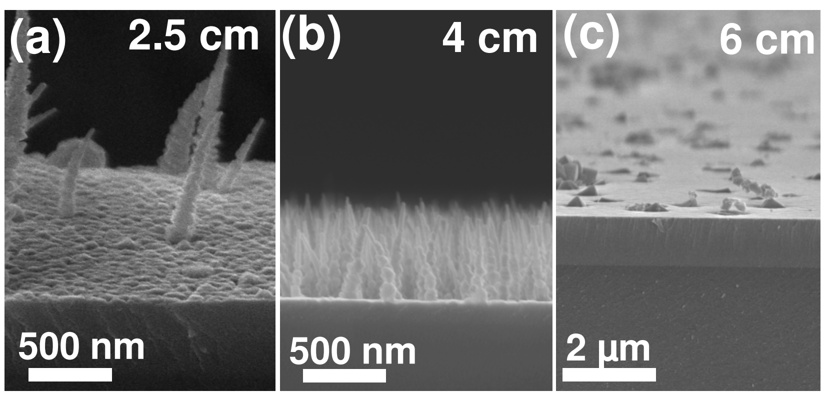

Figure S3 SEM images of PZT NWAs grown at different distances between PZT target and STO substrate from (a) 2.5 cm, (b) 4 cm, and (c) 6 cm with the growth pressure and the substrate temperature of 400 mTorr and 750 ^{o}C for 20 min, respectively.

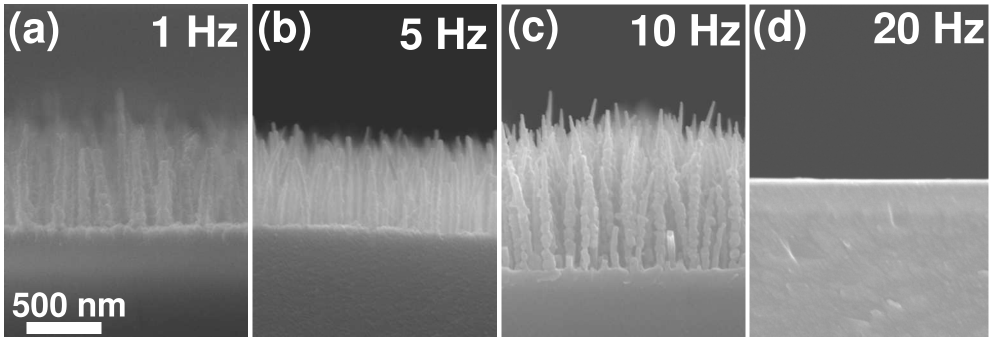

Figure S4 SEM images of PZT NWAs grown at different laser frequencies from (a) 1 Hz, (b) 5 HZ, (c) 10 Hz, and (d) 20 Hz with growth pressure and substrate temperature of 40 mTorr and 750 ^{o}C for 20 min, respectively.

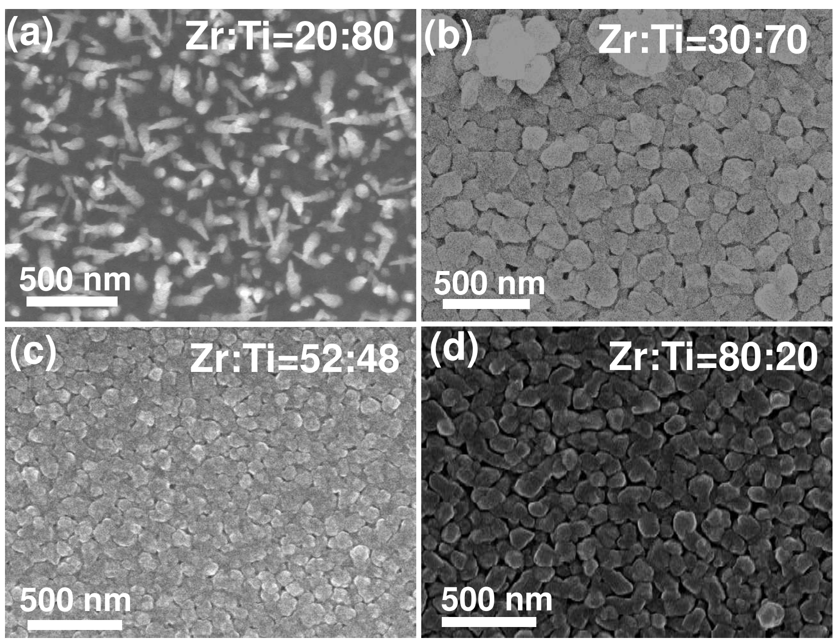

Figure S5. SEM images of PZT NWAs grown by different PZT targets with atomic ratios of Zr/Ti at (a) 20/80, (b) 30/70, (c) 52/48, (d) 80/20 on STO substrate, respectively.

Piezopotential simulation:

The Lippman theory was utilized to calculate the piezopotential distribution in a bent PZT NW. All of the calculations were carried out using the COMSOL 3.5a version package software, which is multiphysics engineering simulation software environment facilitating all steps, namely, defining your geometry, specifying your physics, and then visualizing your results in the modeling process. (More details please refer to http://www.comsol.com/) In this simulation, the bottom side of the bent PZT NW was ground. The material constants used in the calculation are:relative dielectric constants of PZT: $\kappa_{\perp}=504.1$, $\kappa_{\parallel}=270$, the density: $\rho = 7600\, kg/m^3$, the anisotropic elastic constants: C_{11} = 134.8680 GPa, C_{12} = 67.8883 GPa, C_{13} = 68.0876 GPa, C_{33} = 113.297 GPa, C_{44} = 22.2222 GPa, and the piezoelectric constants: e_{15} = 9.77778 C/m^2, e_{31} = –1.81603 C/m^2, e_{33} = 9.05058 C/m^2 Length and diameter of the [001]-orientated PZT NW were set to be 200 nm and 50 nm, respectively. The applied f was set to be 80 nN. A semi-quantitative comprehension can be realized by a numerical calculation without considering the carrier concentration by taking the relative dielectric constants of PZT: $\kappa_{\perp}=504.1$, $\kappa_{\parallel}=270$, the density: $\rho = 7600\, kg/m^3$, the anisotropic elastic constants: C_{11} = 134.8680 GPa, C_{12} = 67.8883 GPa, C_{13} = 68.0876 GPa, C_{33} = 113.297 GPa, C_{44} = 22.2222 GPa, and the piezoelectric constants: e_{15} = 9.77778 C/m^2, e_{31} = –1.81603 C/m^2, e_{33} = 9.05058 C/m^2 into account, respectively