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Supplementary information for

Non-volatile ferroelectric modulation of room temperature electronic transport in La:$BaSnO_3$/$SrTiO_3$/PMN-PT heterostructures

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	1% LBSO/PMN-PT ("w/o STO")	1% LBSO/STO/PMN-PT ("w/ STO")	1% LBSO on STO substrate
ρ (Ω·cm)	1.58	4.3×10^{-2}	6.19×10^{-3}
n (cm^{-3})	1.79×10^{18}	1.57×10^{19}	5.35×10^{19}
μ ($cm^2 V^{-1} s^{-1}$)	2.2	9.1	18.9

Table S1 | Electrical resistivity, carrier concentration, and mobility of 1% La-doped $BaSnO_3$ thin films on PMN-PT (001) substrate with/without STO buffer layer and on STO (001) substrate.

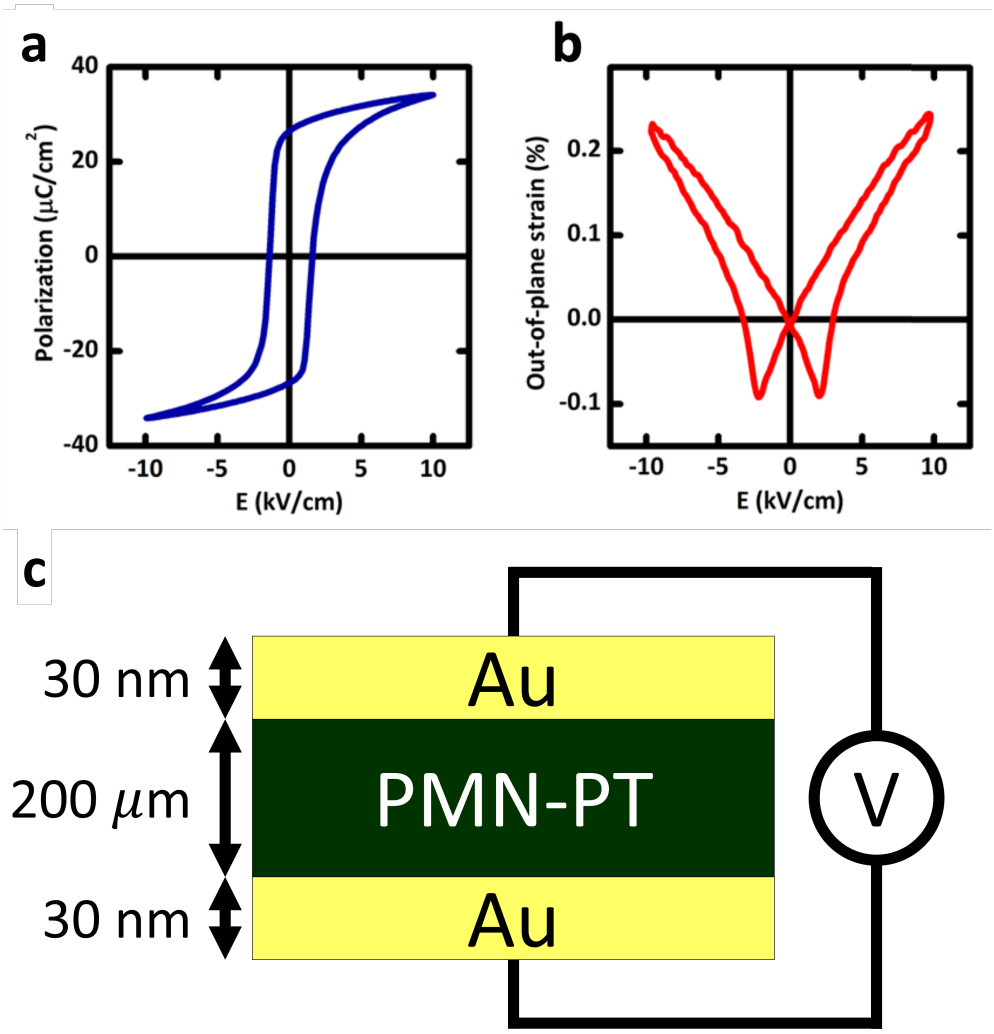

Figure S1 | Ferroelectric and piezoelectric PMN-PT substrate. (a) The P-E hysteresis loop for the PMN-PT substrate at 300 K. (b) Out-of-plane S-E curve for the PMN-PT substrate for the PMN-PT substrate at 300 K. (c) Illustration of the measurement. The converse piezoelectric behavior (S-E hysteresis) and the P-E hysteresis curves of PMN-PT single crystal substrate were measured at 300 K. (30 nm gold metal are used as top and bottom electrode). Laser Displacement Sensor (LK-G10, Keyence Co. Tokyo, Japan, 10 nm resolution with a spot size of 20 μm) are used for S-E curve and and a ferroelectric test system (P-LC100-K, Radiant Technologies, Albuquerque, NM) are used for P-E curve (10 Hz).

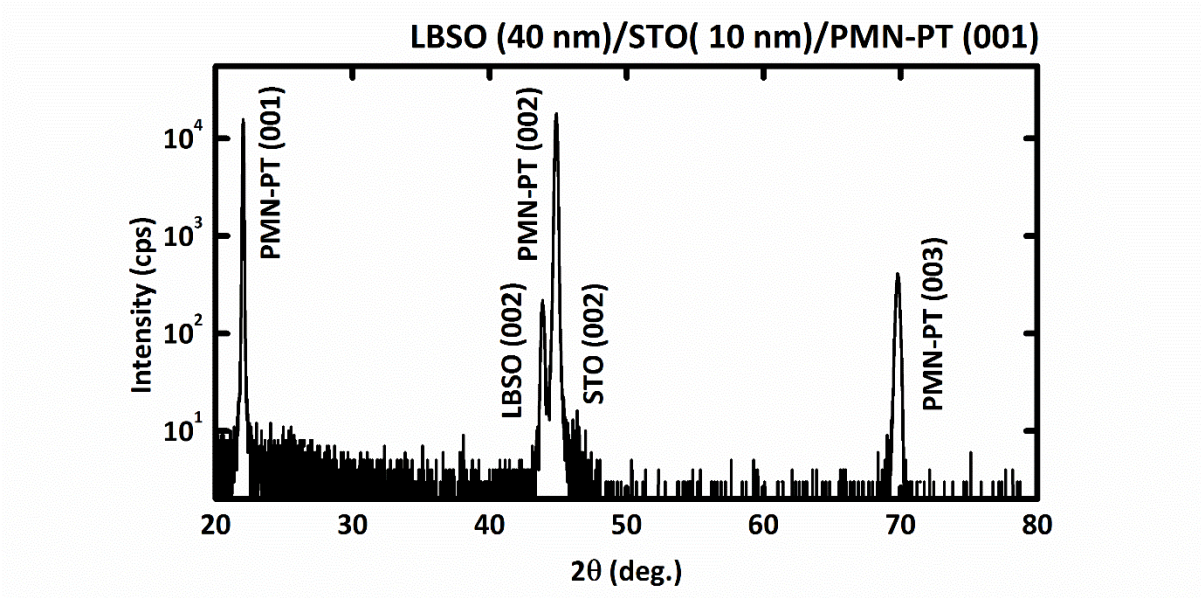

Figure S2 | Wide angle XRD patterns of LBSO/STO/PMN-PT (001). No impurity phases are observed within the detection level of XRD.

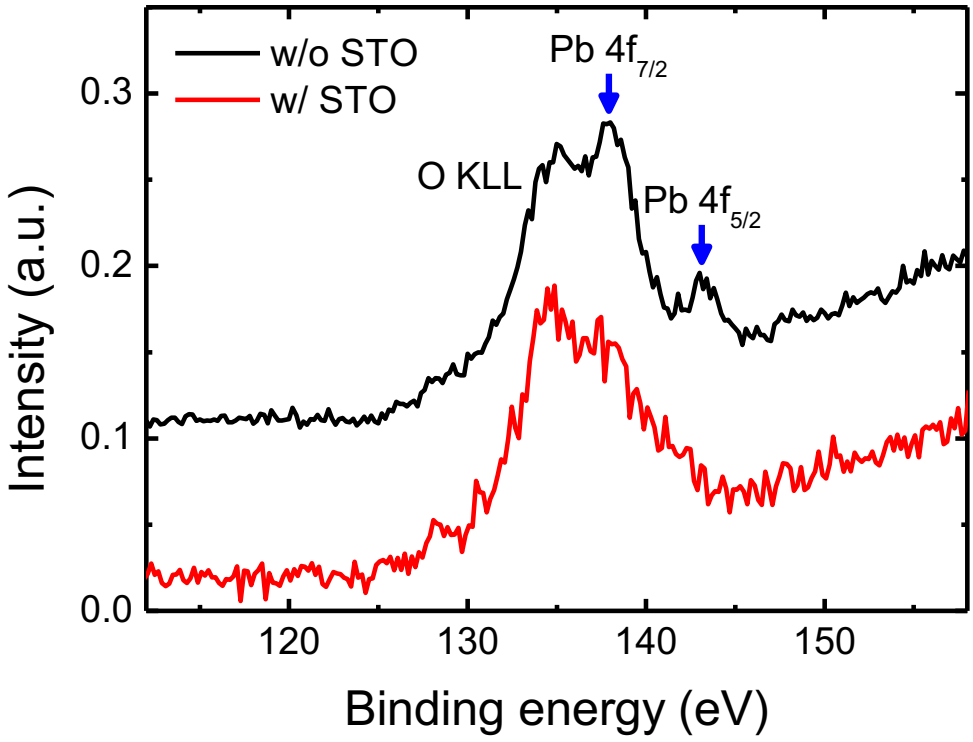

Figure S3 | Synchrotron XPS of 10 nm-thick LBSO thin films with and without STO interlayer. Pb 4f peak appears at the samples without STO interlayer.