Electronic Supplementary Information

Fabrication of nanoporous MTiO$_3$ (M=Pb, Ba, Sr) perovskite array films with unprecedented high structural regularity

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Experimental Procedures

*Electropolishing and two step anodization to fabricate the nanoporous titanate*

First, bare Ti foil (1x1.5cm, 0.25mm thickness) was cleaned by ultrasonication in acetone, isopropyl alcohol, and ethanol. The electropolishing of cleaned Ti foil was carried in a solution with perchloric acid, butanol, and ethanol at 20V for 5min below -20°C. The two-step anodization process was performed in a two-electrode electrochemical cell equipped with Ti foil (anode) and platinum mesh (cathode) under constant voltage. The first potentiostatic anodization process was performed at 60V for 3h at 20°C in a solution of 0.3wt% NH4F and 2 vol% deionized water dissolved in ethylene glycol. As-prepared first anodic TiO2 was removed mechanically. The second anodization was carried on the textured Ti surface at 60V for 30min at 20°C in the same solution.

*Hydrothermal treatment to obtain nanoporous MTiO3 (M=Pb, Ba, Sr) perovskite arrays*

The hydrothermal treatment was carried out in a Teflon-vessel fitted stainless steel reactor containing 0.002M Pb acetate trihydrate, 0.05M Ba hydroxide octahydrate, or 0.05M Sr hydroxide dissolved in 80ml CO2-free water under N2 atmosphere. The reactor was placed in a convection oven at 280°C (PbTiO3), 200°C (BaTiO3), and 200°C (SrTiO3), for 6h without disruption. After the reaction, as-prepared thin film was washed with deionized water and dried in a vacuum oven.

*Sample Characterization*
The Top surface and cross sectional morphology images were obtained by FE-SEM (JEOL JSM-7401F). The crystal structure of the sample was determined by X-ray diffraction (XRD, PANalytical X’Pert diffractometer with an X’Celerator detector) with Cu Kα radiation.

**Perovskite titanate films reported in the literature**$^{1-3}$

**Figure S1.** SEM images: (a) Anodic TiO$_2$ nanotubes$^1$, and (b,c) BaTiO$_3$ nanotubes by hydrothermal synthesis of anodic TiO$_2$ nanotubes shown in (a): (d) Anodic TiO$_2$ nanotubes$^2$, and (e,f) PbTiO$_3$ nanocellular structure by electrodeposition and thermal conversion of (d): (g) Anodic TiO$_2$ nanotubes$^3$, and (h,i) PbTiO$_3$ nanotubes by hydrothermal method of anodic TiO$_2$ nanotubes shown in (g). c, f and i are cross sectional SEM images.
