

Supplementary Materials

Two-Dimensional Perovskite Crystals Formed by Atomic Layer Deposition of CaTiO_3 on $\gamma\text{-Al}_2\text{O}_3$

Tianyu Cao, Ohhun Kwon, Chao Lin, John M. Vohs and Raymond J. Gorte *

Department of Chemical and Biomolecular Engineering, University of Pennsylvania, Philadelphia, PA 19104, USA; caot@seas.upenn.edu (T.C.); ohhun@seas.upenn.edu (O.K.); linchao@seas.upenn.edu (C.L.); vohs@seas.upenn.edu (J.M.V.)

* Correspondence: gorte@seas.upenn.edu

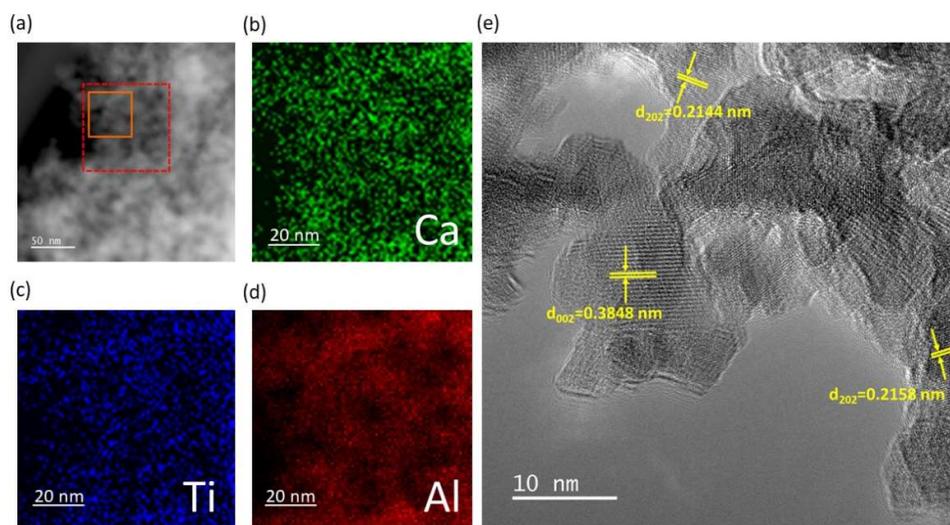


Figure S1. (a) High angle annular dark field (HAADF) STEM image of the 18 wt.% $\text{CaTiO}_3/\text{Al}_2\text{O}_3$ sample; (b), (c) and (d) are EDS maps of Ca, Ti and Al, taken from the region indicated by the dashed red frame; (e) HR-TEM of the sample, image acquired from the orange framed region.

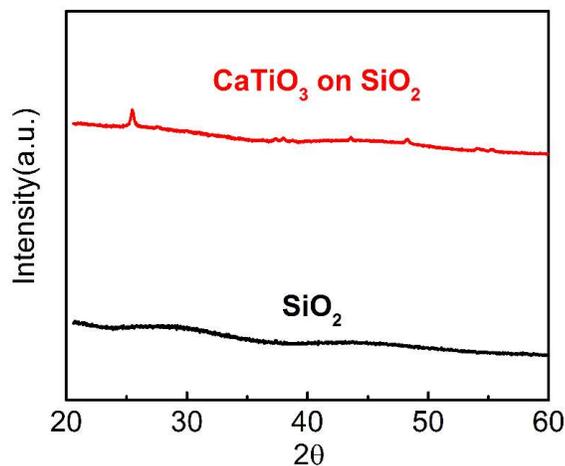


Figure S2. XRD patterns of CaTiO₃ deposited on SiO₂, the black line denotes bare SiO₂ and red line denotes CaTiO₃/SiO₂.

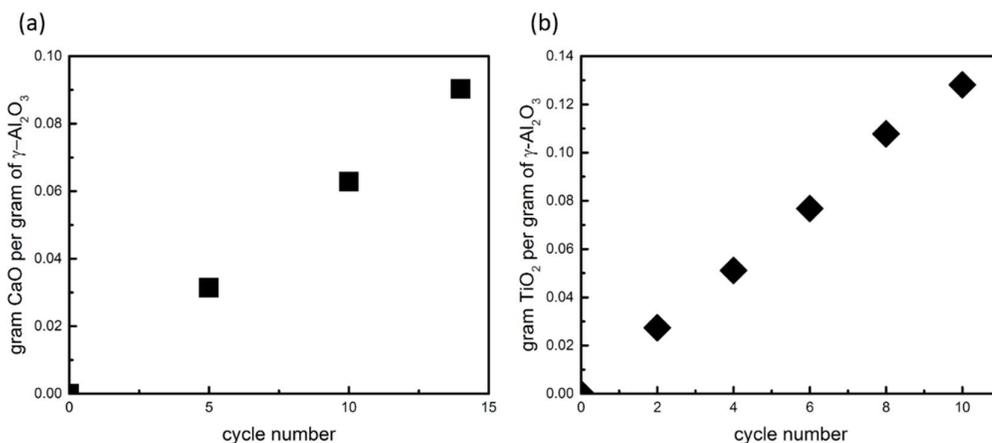


Figure S3. Growth rate of CaO, TiO₂ on γ -Al₂O₃ as a function of ALD cycles. (a)CaO; (b)TiO₂.

Preparation of CaTiO₃ film on the surface of SiO₂

CaO and TiO₂ were deposited to SiO₂ support with ALD. Deposition temperature as well as the precursors used are the same with that has been described in the case of CaTiO₃/Al₂O₃. The silica used was Q-10 SiO₂ powder (CARiACT, Fuji Silysia Chemical Ltd. Greenville, NC, USA). It was calcined in air at 1173 K for 24 h to stabilize. After this thermal treatment, specific area of the SiO₂ was 180 m²/g.

Growth rate of Ca on the surface of SiO₂ was measured to be 5.2×10^{13} atom/cm² cycle, and that for Ti was 7.2×10^{13} /cm² cycle. After every six cycles of CaO, we deposited four cycles of TiO₂, to achieve the 1: 1 stoichiometric ratio between Ca and Ti. Weight of the sample was tracked after each cycle. The ALD process added 0.37 g of CaTiO₃ to every gram of SiO₂ (the weight loading was around 27%), equivalent to a film of 0.5 nm thick. Growth rate of CaO, TiO₂ on SiO₂ as a function of ALD cycles are presented in **Error! Reference source not found.**

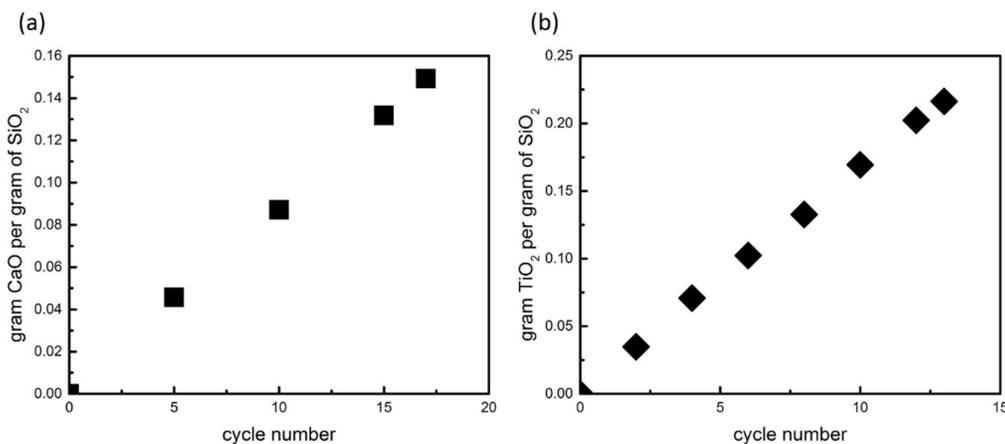


Figure S4. Growth rate of CaO, TiO₂ on SiO₂ as a function of ALD cycles. (a)CaO; (b)TiO₂.

Table S1. Lattice perimeters and d-spacing values of standard CaTiO₃ crystal system.

CaTiO₃, orthorhombic, a=0.5386; b=0.5432; c=0.7610 (nm)	
(hkl)	d-spacing (nm)
(101)	0.4396
(020)	0.2716
(200)	0.2692
(121)	0.2311
(002)	0.3805
(202)	0.2198
(040)	0.1358
(321)	0.1470
(240)	0.1213
(042)	0.1279
(123)	0.1753