Electronic Supplementary Material (ESI) for Materials Advances.

SYNTHESIS OF $SrTiO_3$ and Al-DOPED $SrTiO_3$ via DEEP EUTECTIC SOLVENT ROUTE

Adedoyin N. Adeyemi,[a] Amrit Venkatesh,[a,b] Chengcan Xiao,[c] Zeqiong Zhao,[c] Ying Li,[a] Tori Cox,[a] Dapeng Jing,[b,d] Aaron J. Rossini,[a,b] Frank E. Osterloh,[c] and Julia V. Zaikina.*[a]

a. *Department of Chemistry, Iowa State University, Ames, Iowa 50011, United States.*
b. Ames Laboratory, US DOE, Iowa State University, Ames, Iowa 50011, United States.
c. Department of Chemistry, University of California at Davis, Davis, California 95616, United States.
d. Materials Analysis and Research Laboratory, Iowa State University, Ames, IA 50011, United States.

Supporting Information

Table of Contents

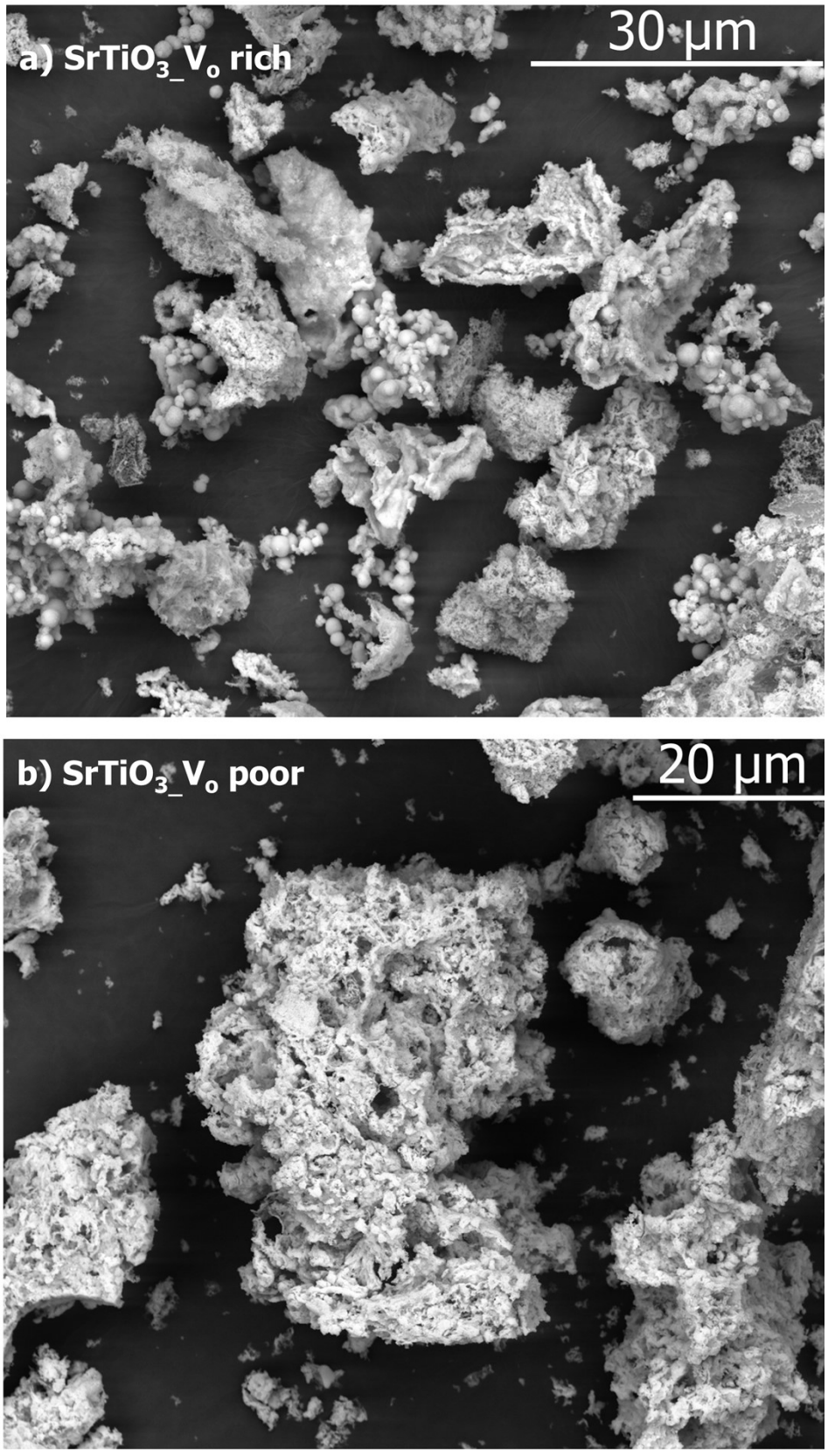

Figure S1: SEM image of a) V_o rich $SrTiO_3$ made with heating profile 1 and b) V_o poor $SrTiO_3$ made with heating profile 2

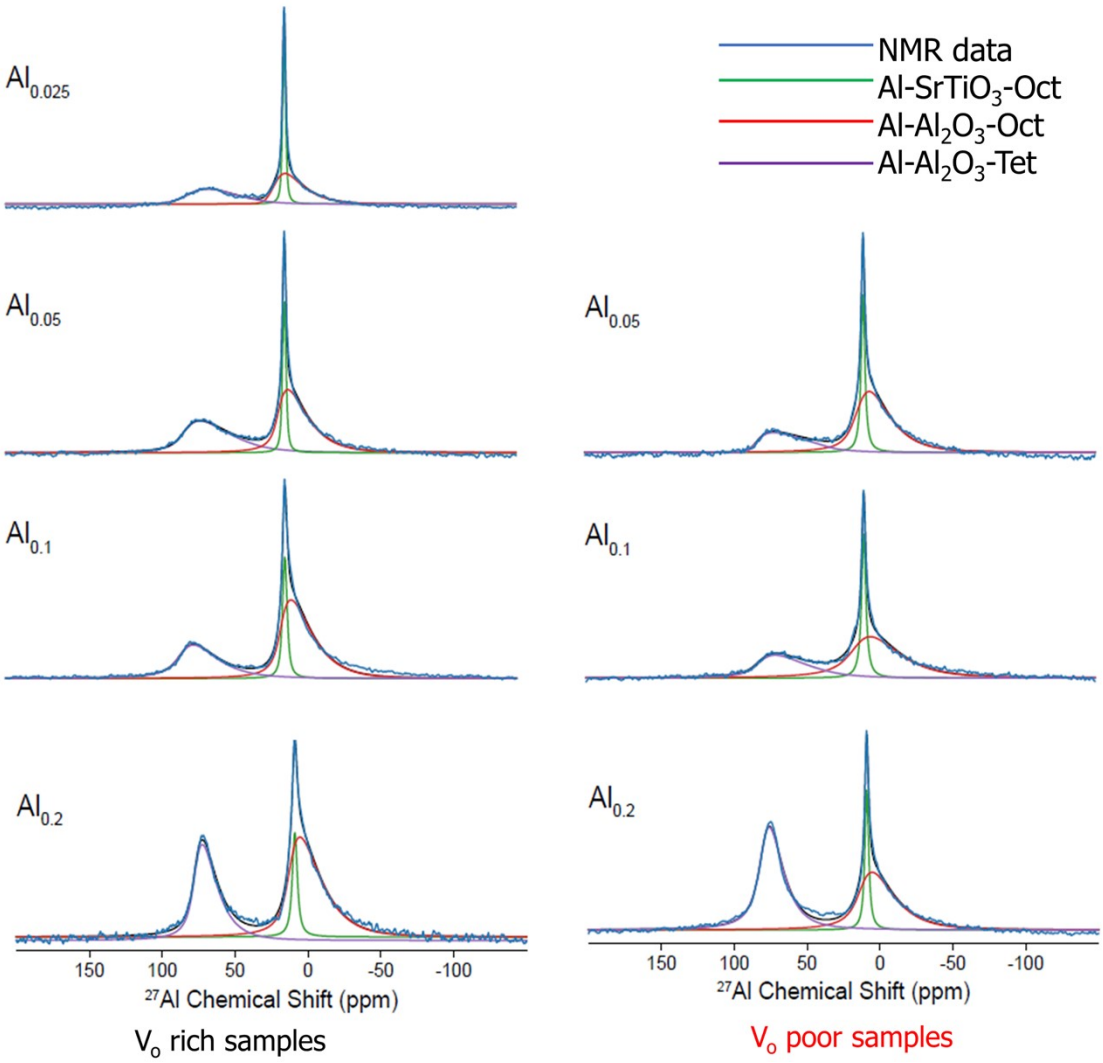

Figure S2: ^{27}Al solid-state NMR. Deconvolution of spectra to three sites where each site is fitted to a Czjzek distribution using the ssNake program. Experimental spectra are shown in blue, simulated spectra are shown in green (doped octahedral sites in perovskite structure), red (octahedral alumina-like sites), purple (tetrahedral alumina-like sites) and black (sum of all three simulated sites). For all fits, a library of 500 points was used (50 points along C_Q within 0 and 8 MHz and 10 points along η within 0 and 1). The number of independent random components of the quadrupolar tensor (*d*) was set to 5. The standard deviation of the quadrupole distribution (σ) and the Lorentz/Gaussian line broadening paramteres were freely varied to obtain the best fit of the three sites. The fit σ values for the Al-$SrTiO_3$-Oct, Al-Al_2O_3-Oct and Al-Al_2O_3-Tet sites were within the ranges 0.2-0.3, 2.1-2.6 and 1.9-4.2 MHz, respectively.

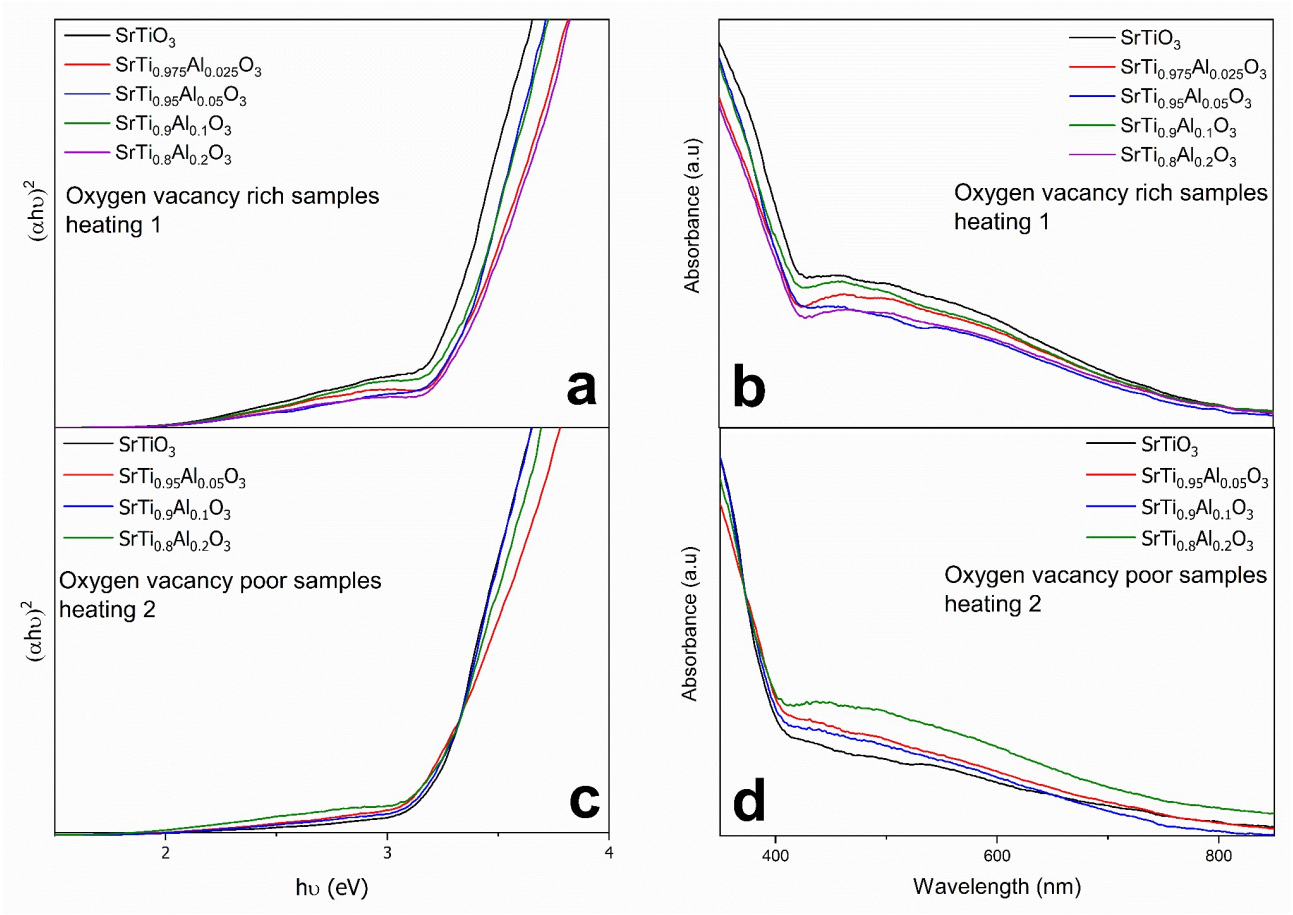

Figure S3:(a) Tauc plots and (b) Uv-vis spectra of V_O rich samples made with heating profile 1; (c) Tauc plots and (d) UV-Vis spectra of V_O poor samples made with heating profile 2.

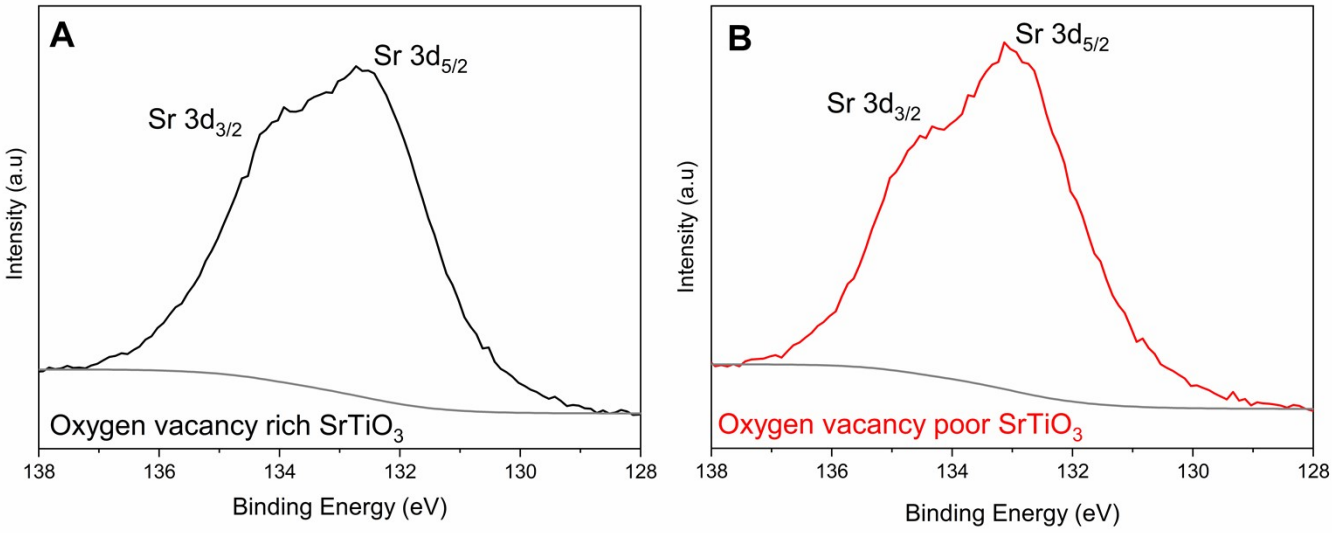

Figure S4: XPS data of the Sr 3*d* region for :(a) oxygen vacancy rich $SrTiO_3$ made with heating profile 1 and (b) oxygen vacancy poor $SrTiO_3$ made with heating profile 2

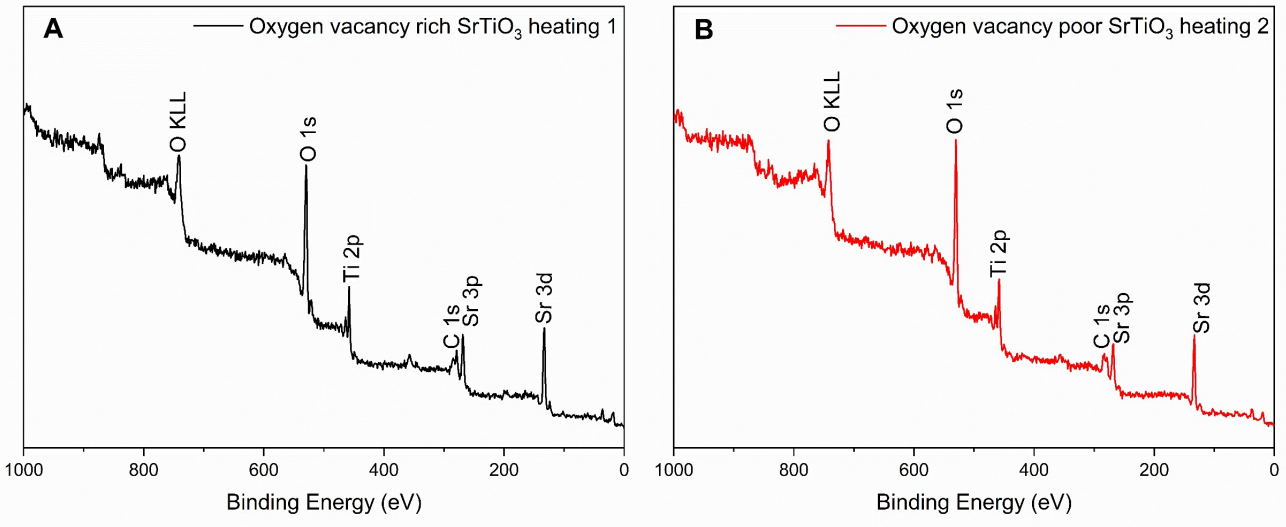

Figure S5: XPS survey spectra of :(a) V_O rich $SrTiO_3$ made with heating profile 1 and (b) V_O poor $SrTiO_3$ made with heating profile 2.

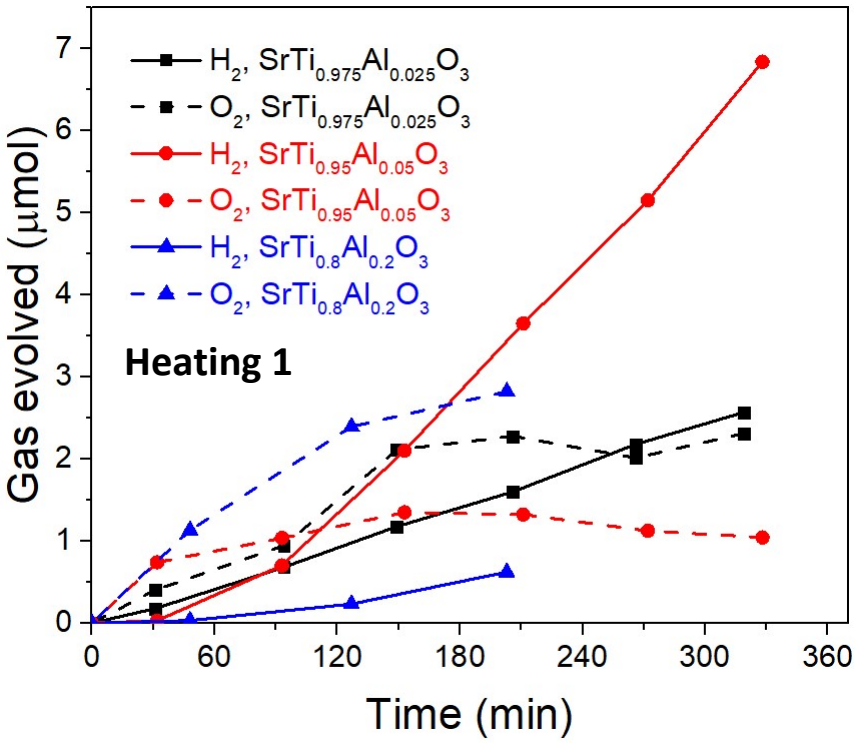

Figure S6: Photocatalytic hydrogen (solid line) and oxygen (dash line) evolution results of $Rh_xCr_{2-x}O_3/SrTi_{0.975}Al_{0.025}O_3$ (black curves), $Rh_xCr_{2-x}O_3/SrTi_{0.95}Al_{0.05}O_3$ (red curves) and $Rh_xCr_{2-x}O_3/SrTi_{0.8}Al_{0.2}O_3$ (blue curves) V_O rich samples in water made by heating profile 1. The UV intensity was 100 mW/cm^2. Detected oxygen traces are attributed to residual dissolved O_2 in the reaction mixture.

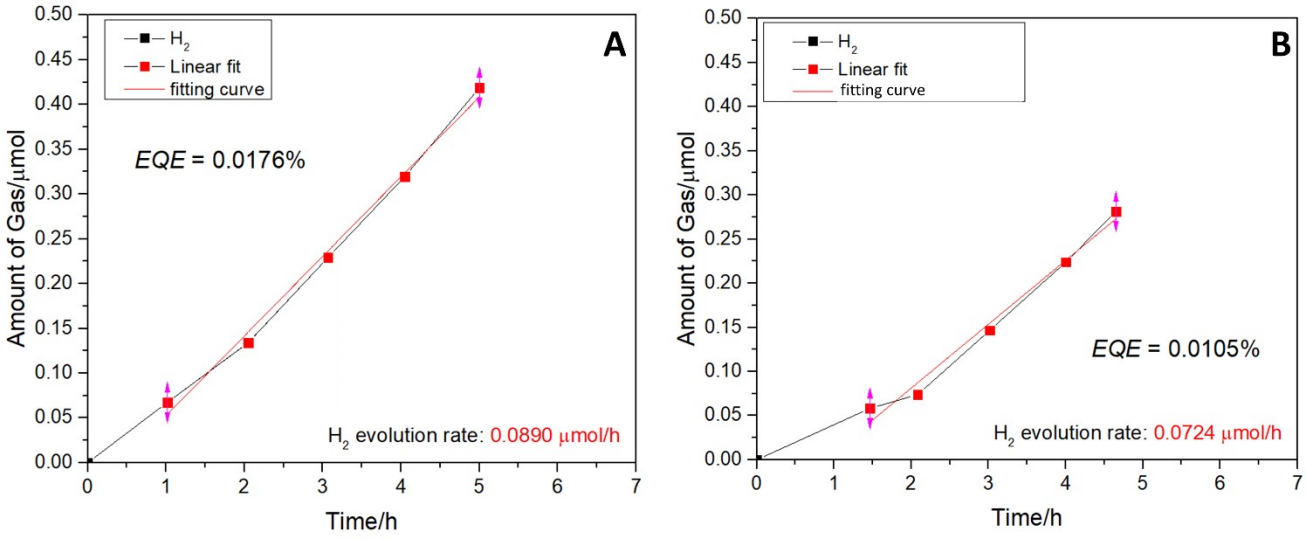

Figure S7: External quantum efficiency of H_2 evolution for a) V_O rich $Pt/SrTiO_3$ and b) V_O rich $Pt/SrTi_{0.9}Al_{0.1}O_3$ (heating 1). Conditions: 100 mg catalyst in 118 mL of 20% aqueous methanol. For a) LED 375 nm with 58.7 mW/cm^2 and for b), LED 375 nm with 80.0mW/cm^2. Apparent quantum efficiency values are listed in table S1.

Table S1. External Quantum Efficiency (EQE) data for $Pt/SrTiO_3$ and $Pt/SrTiO_3$:Al (heating 1). Average EQE values were calculated on the basis of two separate measurements.

Samples	**EQE (%)**	**Average EQE (%)**
$Pt/SrTiO_3$	0.0170	0.0173
	0.0176	
$Pt/SrTi_{0.9}Al_{0.1}O_3$	0.0121	0.0113
	0.0105	

Calculation of External Quantum Efficiency (EQE) was based on the below equation.

$$EQE = \frac{electrons/sec}{photons/sec} = \frac{2 \times (moles\ of\ H_2/sec) \times N_A}{(power\ of\ light)/(\frac{hc}{\lambda})}$$

Where N_A is the Avogadro's number, h is the Planck's constant, c is the speed of light and λ is the wavelength of light (375nm in this case).