Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.

Analysis of charge trapping and long lived hole generation in $SrTiO_3$ photoanodes

Anna A. Wilson,[a] Thomas Shalvey,[b] Andreas Kafizas,[a,c] Asim Mumtaz,[d] James R. Durrant[a,e]

[a]*Department of Chemistry and Centre for Processable Electronics, Imperial College London, London, W12 0BZ, UK, j.durrant@imperial.ac.uk*
[b]*Stephenson Institute for Renewable Energy, Department of Physics, University of Liverpool, Liverpool, L69 7ZF, UK*
[c]*London Centre for Nanotechnology, Imperial College London, SW7 2AZ, UK*
[d]*School of Physics, Electronics & Technology, University of York, Heslington, York, YO10 5DD, UK*
[e]*SPECIFIC IKC, College of Engineering, Swansea University, Swansea, SA2 7AX, UK*

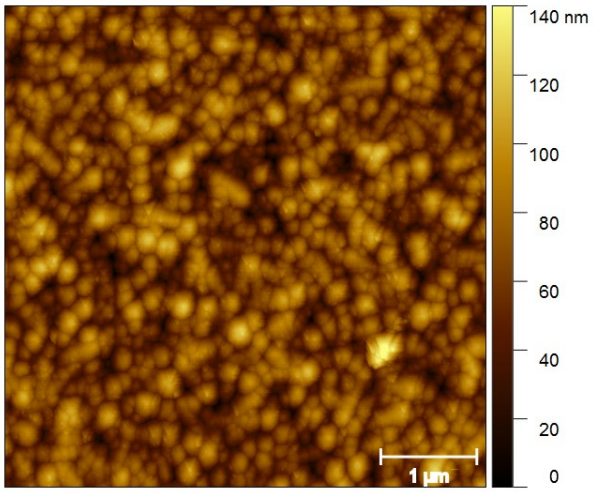

Figure S1: 2D AFM image of the $SrTiO_3$ surface. The surface is relatively flat with a roughness factor of 1.1, calculated by dividing the actual surface area (27.3 µm^2) by the projected surface area (25.0 µm^2).

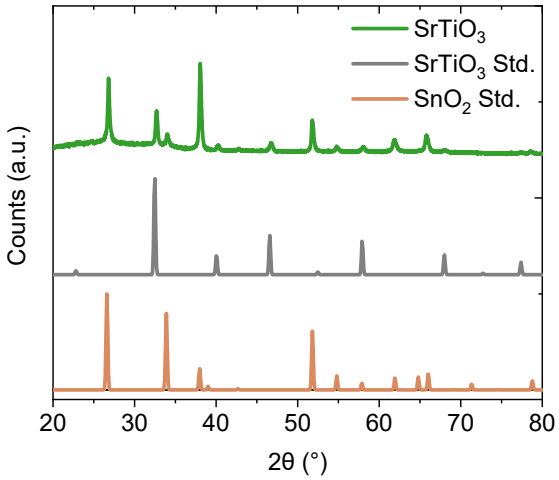

Figure S2: XRD pattern of the $SrTiO_3$ on FTO (F-doped SnO_2) investigated in this work, compared to standard XRD patterns of $SrTiO_3$ (ICDS collection no: 23076) and SnO_2 (ICDS collection no: 9163).

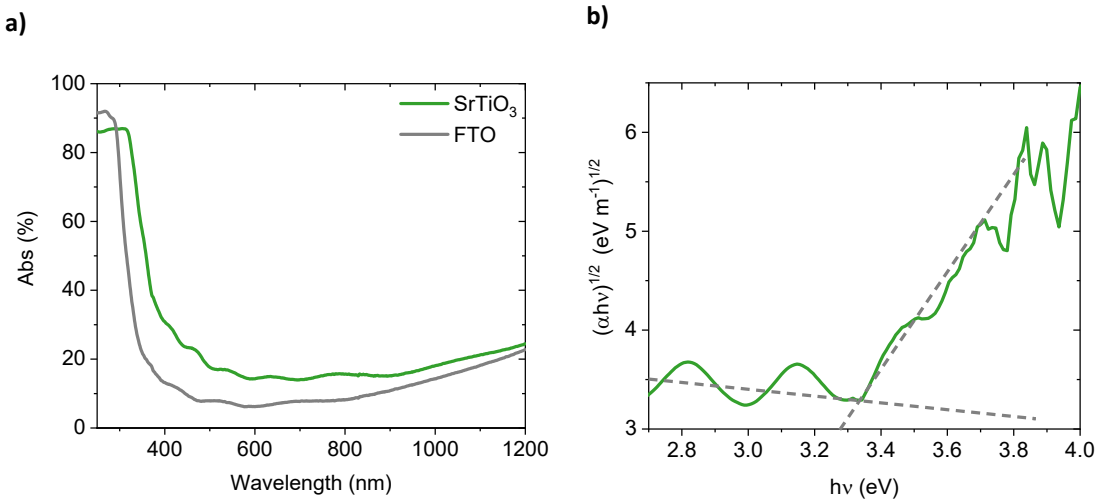

Figure S3: Steady-state spectra of $SrTiO_3$/FTO compared to FTO, a) the absorbance, and b) Tauc plot giving an estimated band gap of 3.3-3.4 eV. It is noted that due to the large degree of noise this is an approximate value.

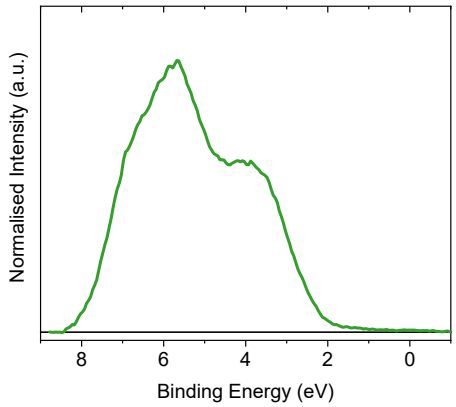

Figure S4: XPS of the valence band energy region of the $SrTiO_3$ photoanode.

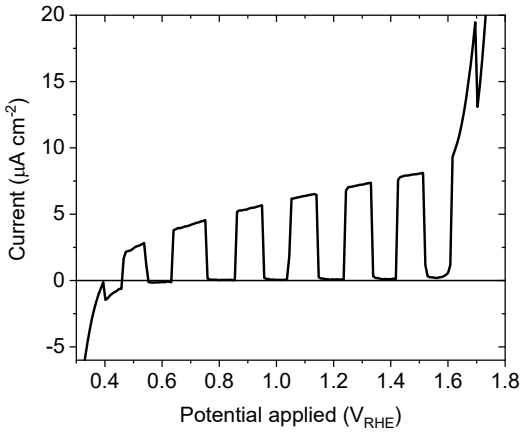

Figure S5: Chopped light J-V response of $SrTiO_3$, measured using illumination from a 365 nm LED at approximately 1 sun illumination intensity (2.8 mW cm^{-2}).

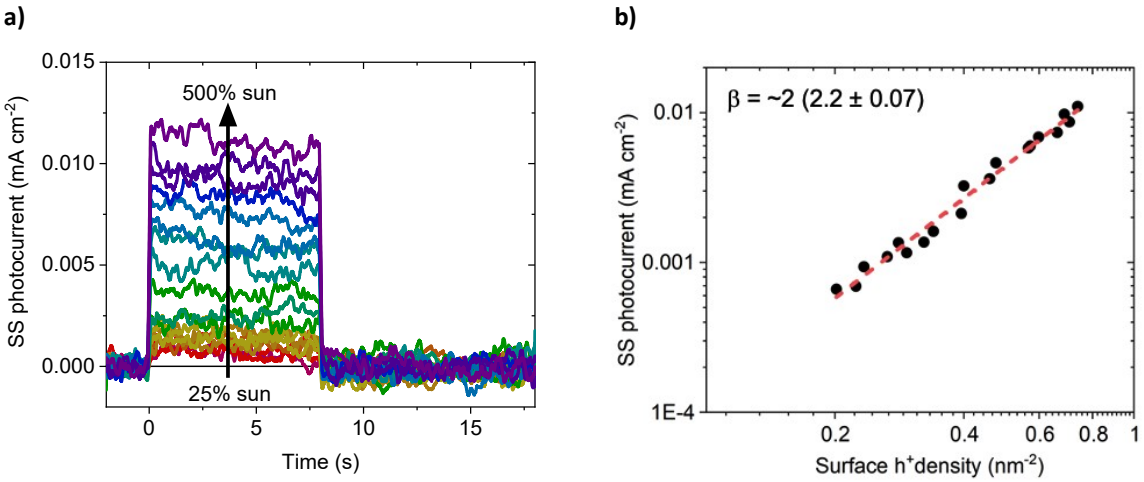

Figure S6: Measurements undertaken under an applied bias of 1.3 V_{RHE} and with increasing LED excitation intensities. a) Steady-state TPC measurements. b) Rate law analysis plot of the steady-state photocurrent (taken from the TPC in b)) measured simultaneously with the steady-state optical hole signal (taken from the PIAS in a)). The steady-state optical hole signal was converted into a surface h^+ using the calculated extinction coefficient of 2200 M^{-1} cm^{-1}. The gradient of two for the linear suggests a second order reaction with respect to the hole density.

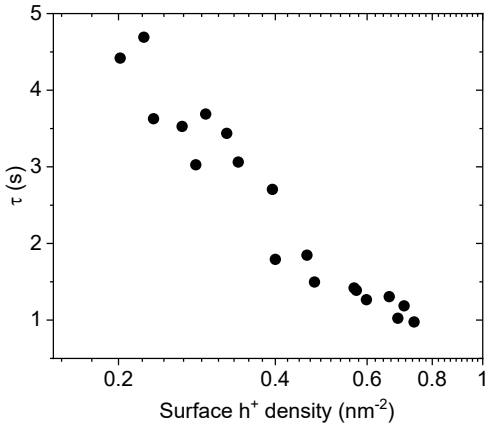

Figure S7: Calculated reaction time constant, τ, of hole species in $SrTiO_3$ on FTO at a range of hole densities. Undertaken under an applied bias of 1.3 V_{RHE}.