Supporting information for

Revealing the Charge Transport Mechanism of a Photoelectrochemical cell: Analysis by A.C. voltage perturbation

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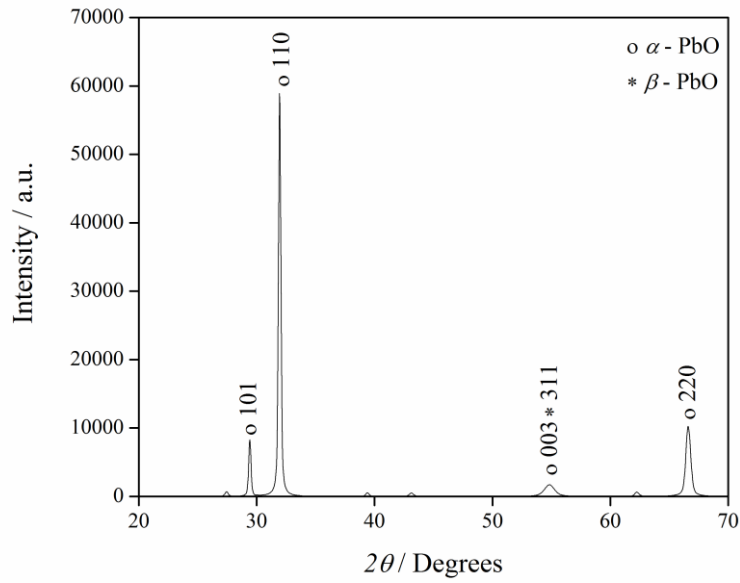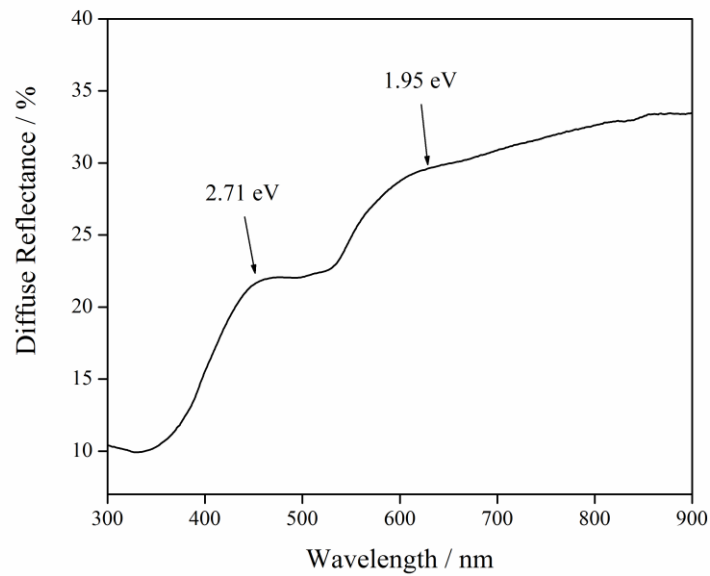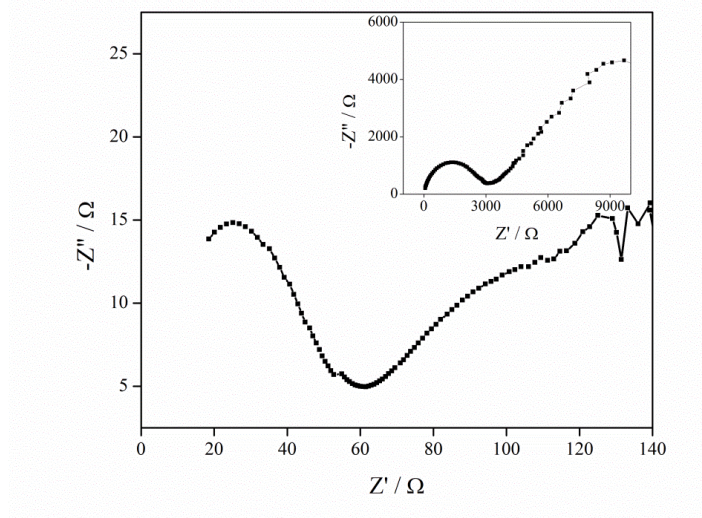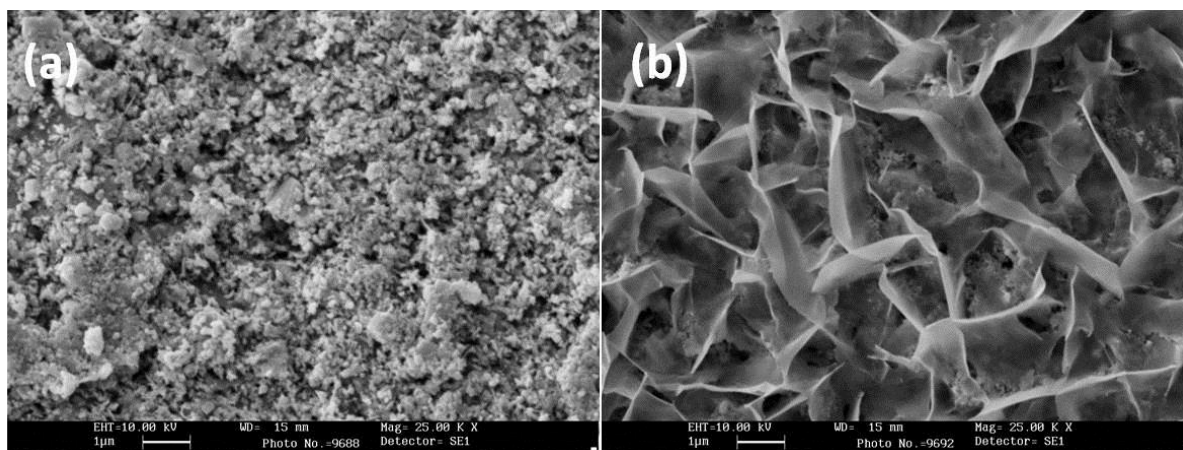Phone: +91-79-23275303. Fax: +91-79-23275030

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Figure 1 The XRD spectrum of used PbO$_x$ thin film.

SI-Figure-2 The diffused reflectance spectrum of the PbO$_x$ film (1.95 and 2.71 eV band gaps corresponds to α-PbO and β-PbO, respectively)

SI-Figure-3: The Nyquist plot for the less porous film (SI-Figure-2 (a)) to assign the first semi-circle to the charge transfer resistance.

SI-Figure-4: FE-SEM images of the anodized lead electrode by (a) potentiodynamic and (b) potential pulse electrodeposition method.
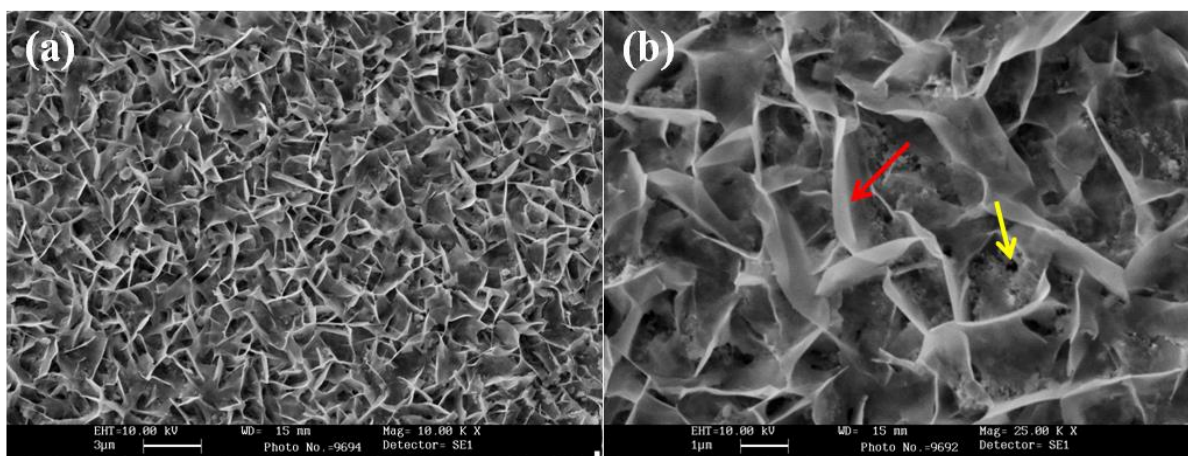
SI-Figure-5: FE-SEM images of the anodized lead electrode showing vertically aligned inter-connected nanowalls having nano-pores on the walls (marked with RED arrow) and in the underneath layer (marked with YELLOW arrow).
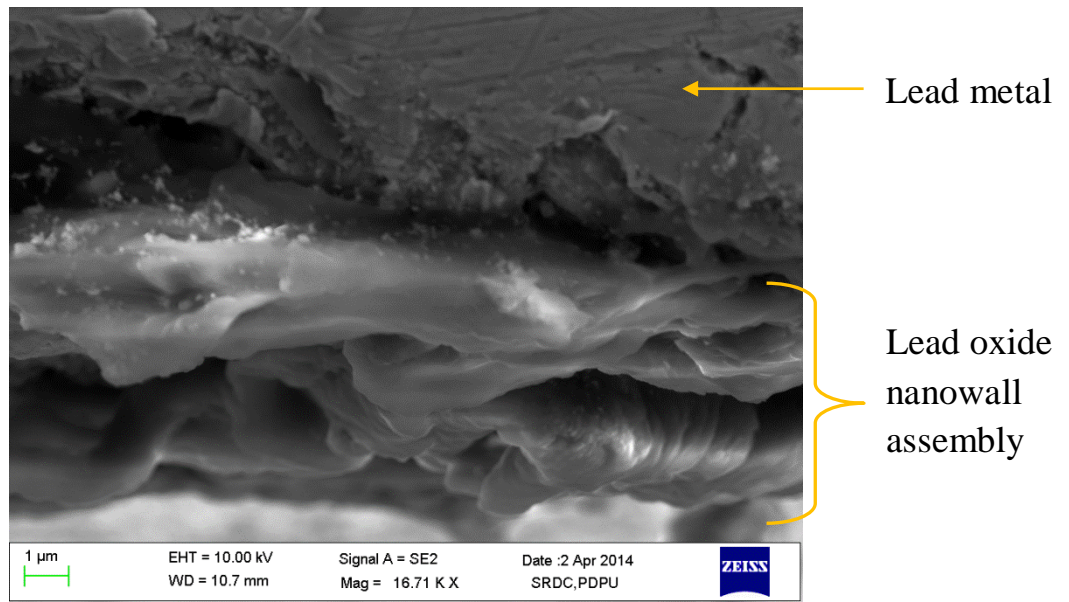
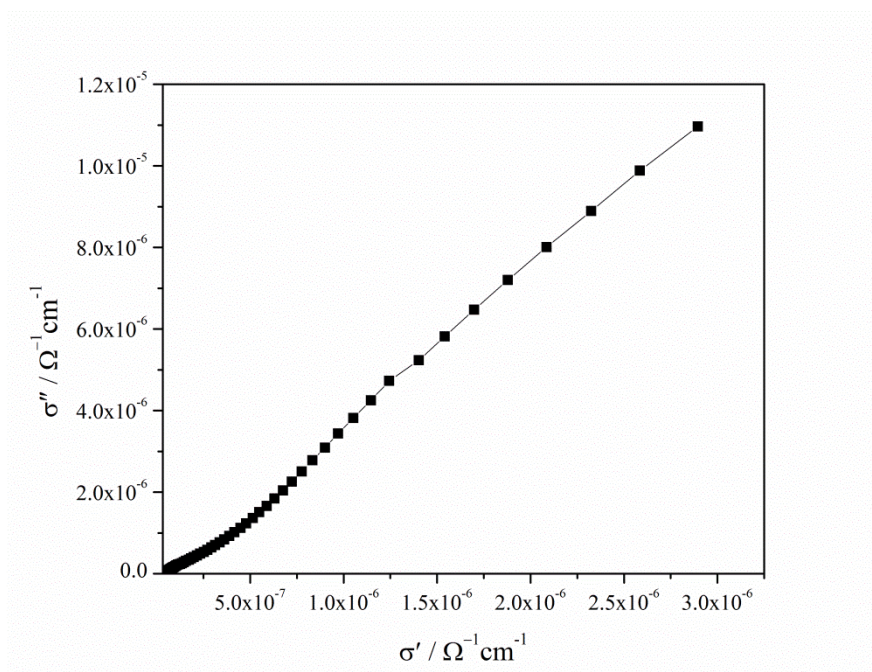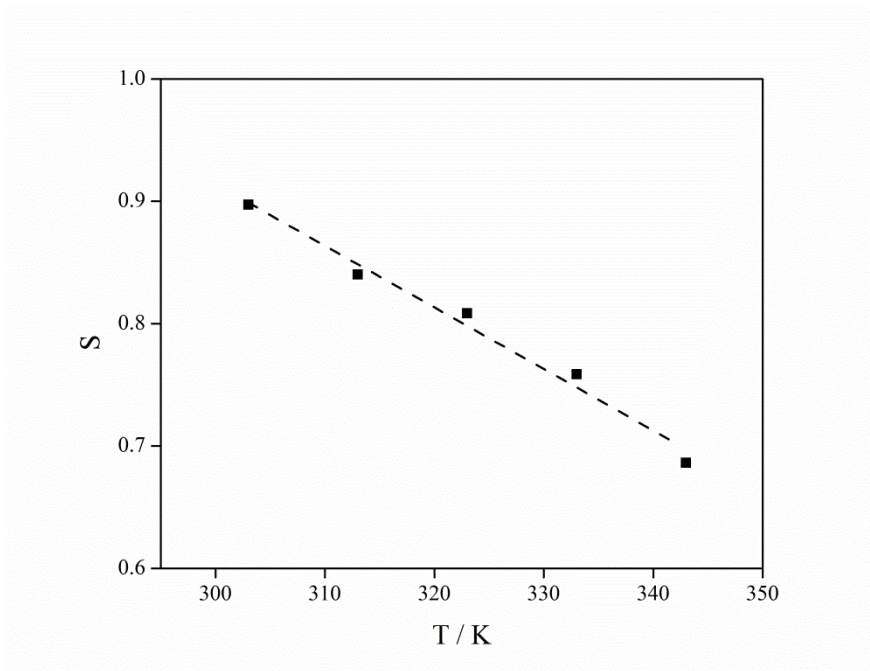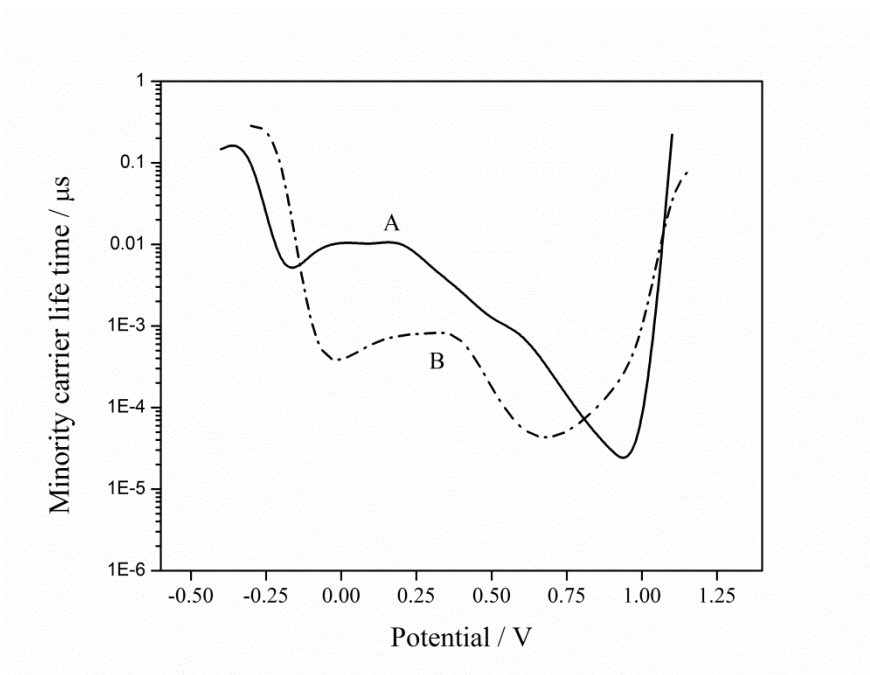SI-Figure-6: A cross sectional view of anodized PbO$_x$ electrode.

SI-Figure-7: Nyquist plot of A.C. conductivity for the extraction of D.C. conductivity from higher frequency region.

SI-igure-8: Variation of frequency exponent in universal power law with temperature to choose the CBH model for the assignment of current mechanism.

SI-Figure-9: Variation of minority carrier life time (calculated from the $R_{rec}CPE2$ time constant of the fitted circuit) with bias under (A) dark and (B) illumination conditions.

SI-Table-1 Fitted circuit parameters at select potentials

Potential / V (vs. Hg/HgO)	R_{ct} / Ω	R_{rec} / Ω	CPE1 / F cm^{-2}	CPE2 / F cm^{-2}
-0.6	33	45	5 E-07	1.79 E-07
-0.5	120	1186	4.5 E-04	3.94 E-04
0.3	1888	3007	6.83 E-05	2.7 E-07
0.8	669	249	4.3 E-03	2.59 E-07