Electronic Supplementary Information (EIS)

High Current Density Cation-exchanged SnO_2-CdSe/ZnSe and SnO_2-CdSe/SnSe Quantum-dot Photoelectrochemical Cells

Mu. Naushad[a*], M. R. Khan[a], Sambhaji S. Bhande[b,*], Shoyebmohamad F. Shaikh[b], S. M. Alfadul[c], Pritamkumar V. Shinde[b], Rajaram S. Mane[b,*]

[a]Department of Chemistry, College of Science, Bld#5, King Saud University, Riyadh, Saudi Arabia, [b]School of Physical Sciences, SRTM University, Nanded, India, [c]King Abdulaziz City for Science and Technology Riyadh Saudi Arabia.

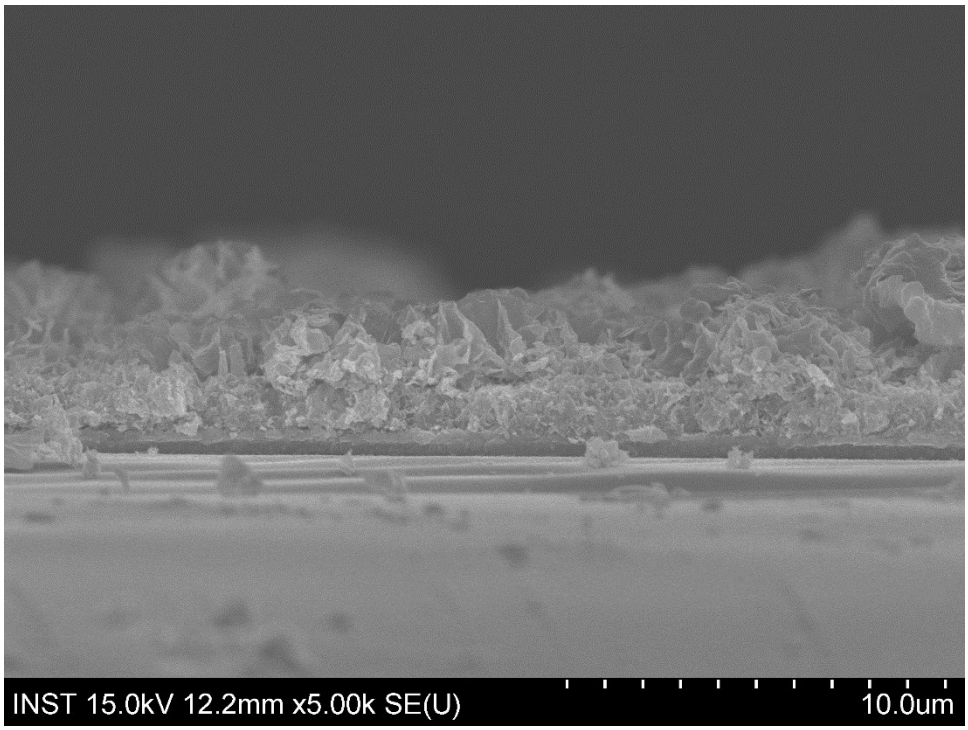

Fig. S1 FE-SEM plane-view cross-section images of SnO_2.

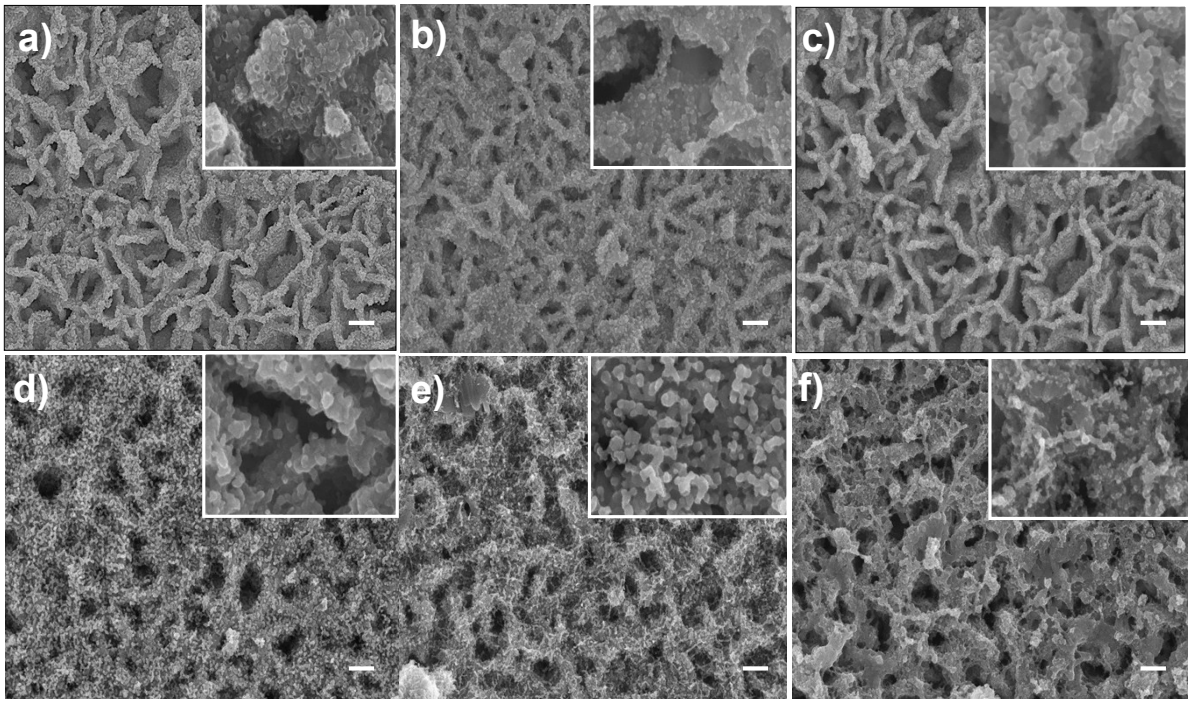

Fig. S2 FE-SEM plane-view images of a) SnO_2-CdSe/ZnSe (10 min), b) SnO_2-CdSe/ZnSe (30 min), c) SnO_2-CdSe/ZnSe (60min), d) SnO_2-CdSe/ZnSe (90 min), e) SnO_2-CdSe/ZnSe (120 min), f) SnO_2-CdSe/ZnSe (150min), (scale bar= 1 μm). Inset shown high resolution 300 nm FE-SEM photo image.

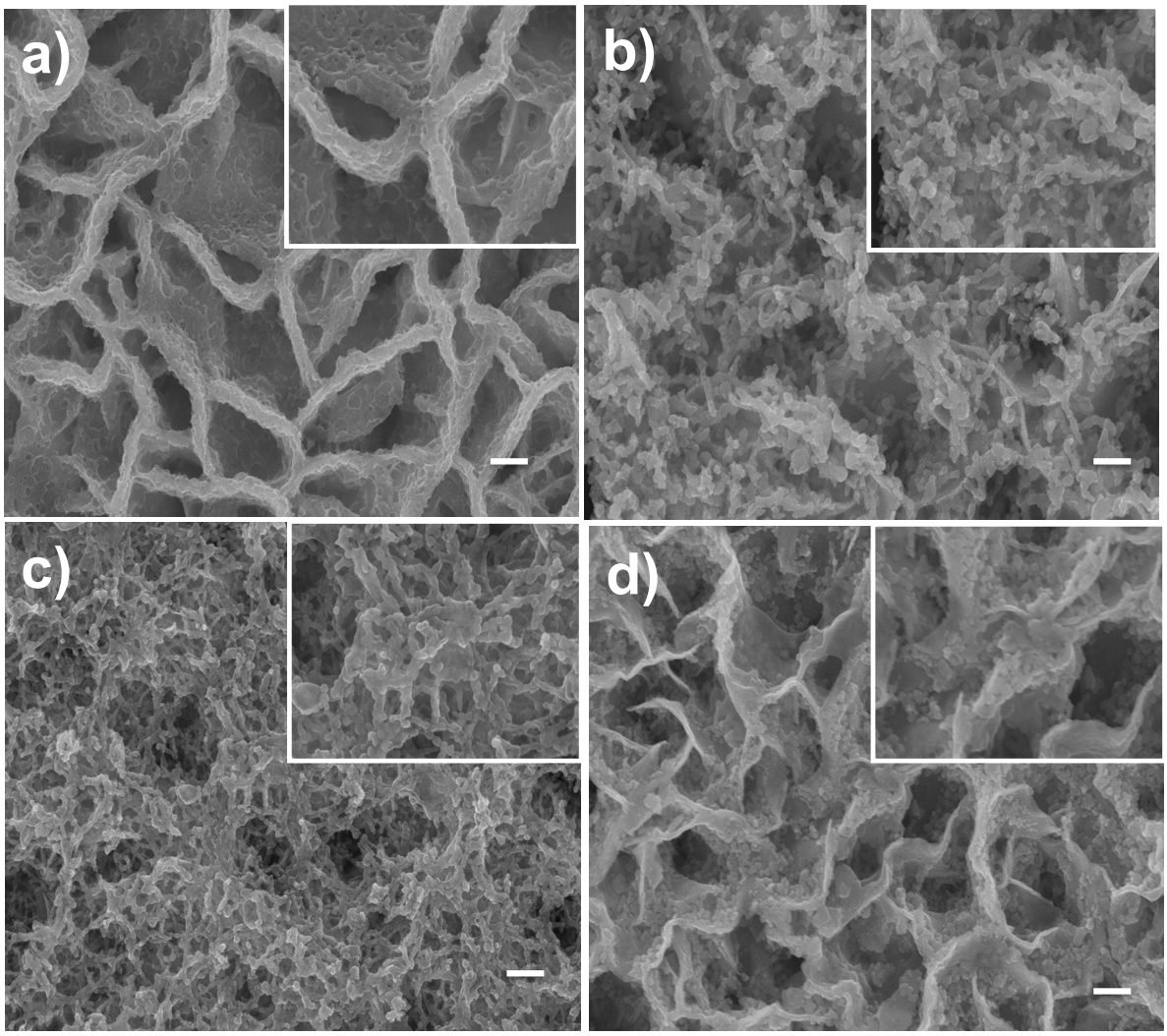

Fig. S3 FE-SEM plane-view images of a) SnO_2-CdSe/SnSe (15 min), b) SnO_2-CdSe/SnSe (30 min), c) SnO_2-CdSe/SnSe (45min),and d) SnO_2-CdSe/SnSe (60 min), (scale bar= 1 µm). Inset shown high resolution 300 nm FE-SEM photo image.

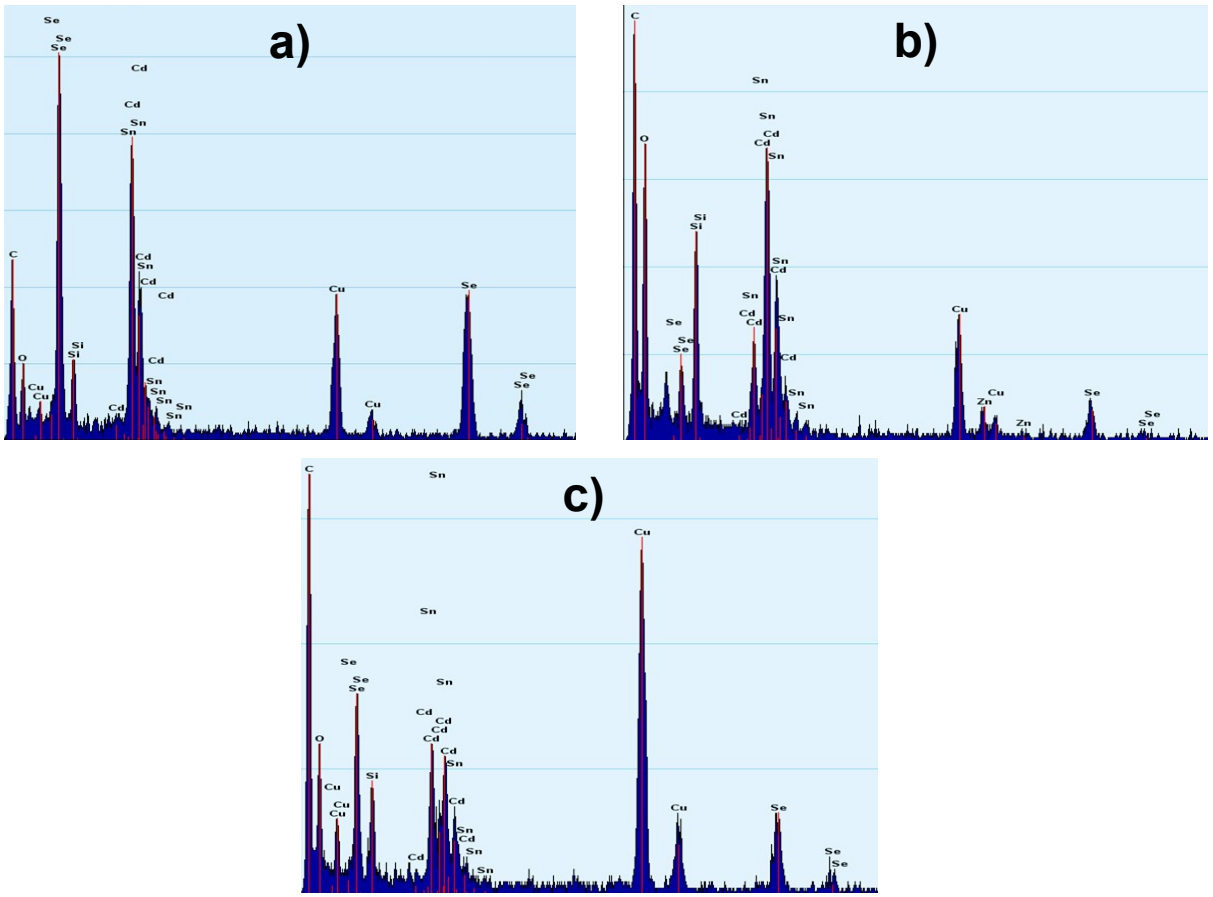

Fig. S4 EDX analysis of HR-Tem image of a) SnO_2-CdSe, b) SnO_2-CdSe/ZnSe, and c) SnO_2-CdSe/SnSe on cupper grid substrate.

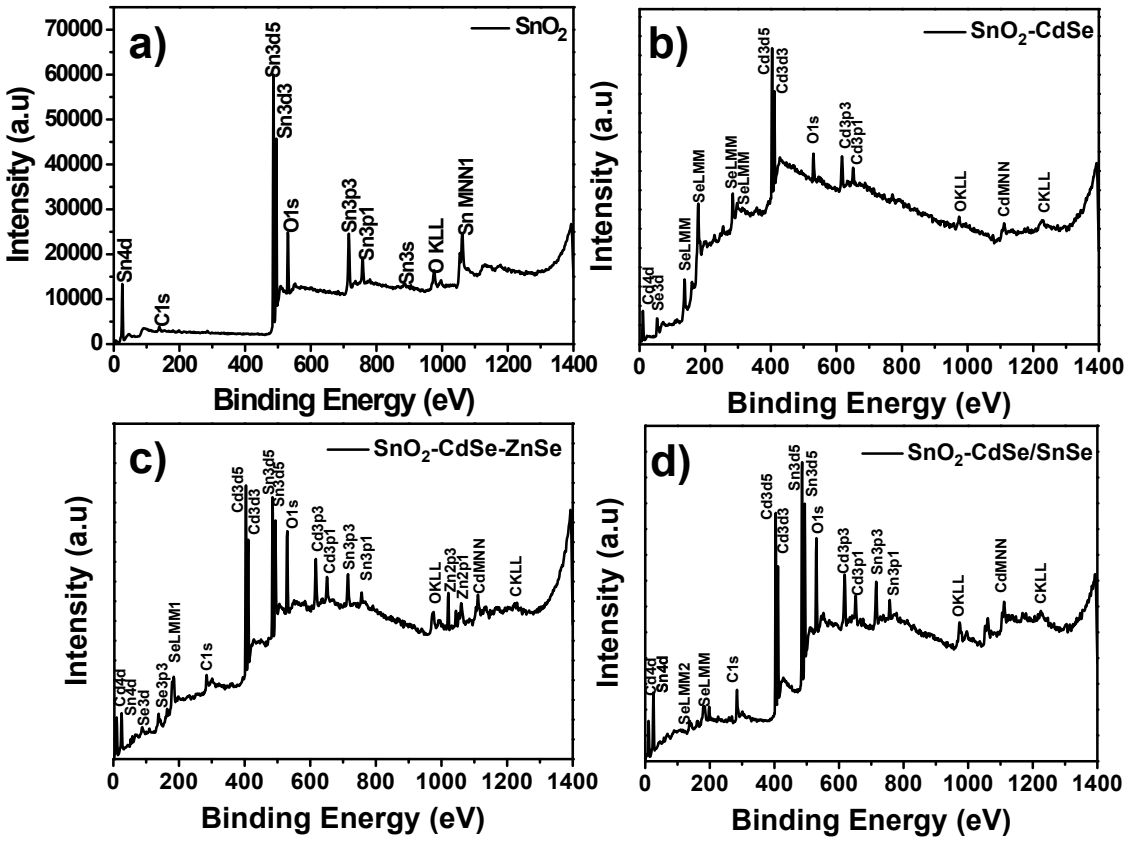

Fig. S5 Binding energy survey spectra of a) SnO_2, b) SnO_2-CdSe, c) SnO_2-CdSe/ZnSe, and d) SnO_2-CdSe/SnSe photoanode.

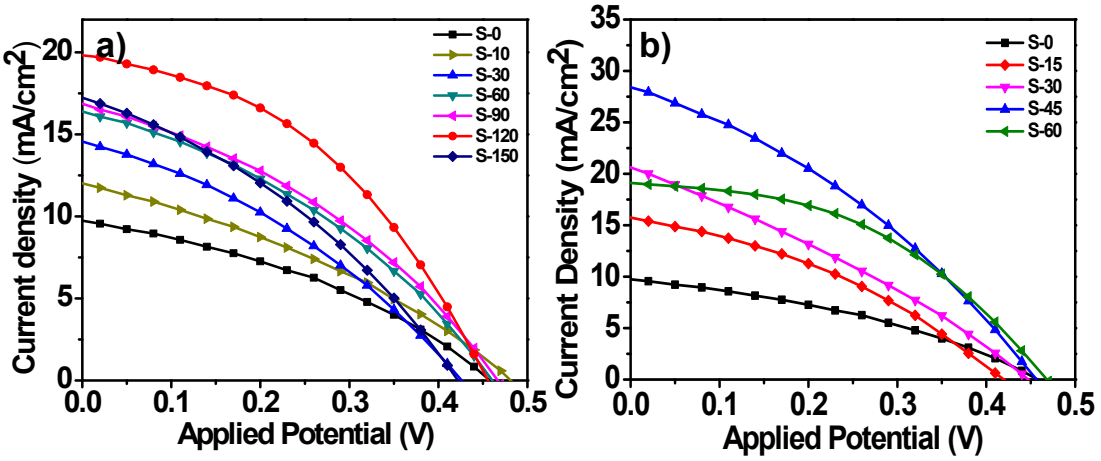

Fig. S6 *JV* curve data collected in the reverse (0.4-0V) scan direction at various ion-exchange interface modification time a) SnO_2-CdSe/ZnSe (10-150 min), and b) SnO_2-CdSe/SnSe (15-60 min) photoanode.

Table S1 Summary of photovoltaic performances of the SnO_2-CdSe/ZnSe (10-150 min), and b) SnO_2-CdSe/SnSe (15-60 min) devices fabricated at various ion-exchange interface modification time periods.

Photoanode	J_{sc} **(mA cm^{-2})**	V_{oc} **(V)**	*ff* **(%)**	**PCE (%)**
SnO_2	**9.74**	**0.46**	**0.36**	**1.63**
SnO_2-CdSe/ZnSe (10min)	**12.02**	**0.48**	**0.34**	**1.94**
SnO_2-CdSe/ZnSe (30min)	14.57	0.43	0.35	2.13
SnO_2-CdSe/ZnSe (60min)	16.46	0.46	0.35	2.67
SnO_2-CdSe/ZnSe (90min)	16.87	0.47	0.36	2.84
SnO_2-CdSe/ZnSe (120min)	**19.82**	**0.46**	**0.42**	**3.78**
SnO_2-CdSe/ZnSe (150min)	17.24	0.42	0.35	2.52
SnO_2-CdSe/SnSe (15min)	15.74	0.42	0.35	2.37
SnO_2-CdSe/SnSe (30min)	20.62	0.47	0.40	3.20
SnO_2-CdSe/SnSe (45min)	**28.40**	**0.47**	**0.48**	**4.41**
SnO_2-CdSe/SnSe (60min)	19.11	0.47	0.45	3.99

Table S2 EIS analysis and various parameters calculated from EIS measurements.

Photoanodes	R_{ct}	R_1	R_2
SnO_2-CdSe	2.52	21.9	110.1
SnO_2-CdSe/ZnSe	1.62	19.1	81.3
SnO_2-CdSe/SnSe	1.58	16.0	68.2