

Supplementary Information

**Multi-elemental chalcogenide n -BiCdSe films grown under
controlled depth voltammetry: Improved photo-electrochemical
behaviour toward energy conversion**

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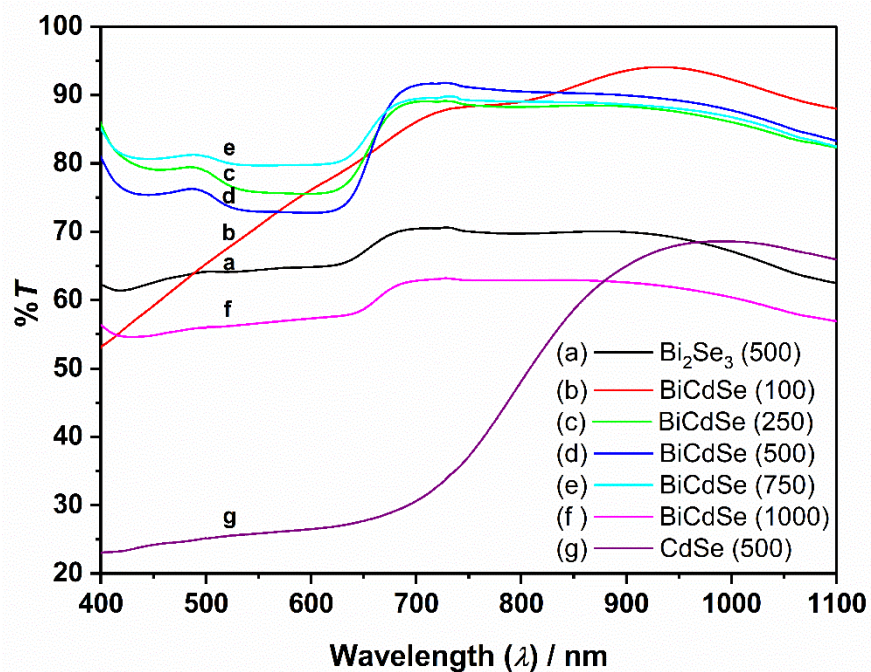


Fig. S1. Transmittance spectra of the synthesized thin films.

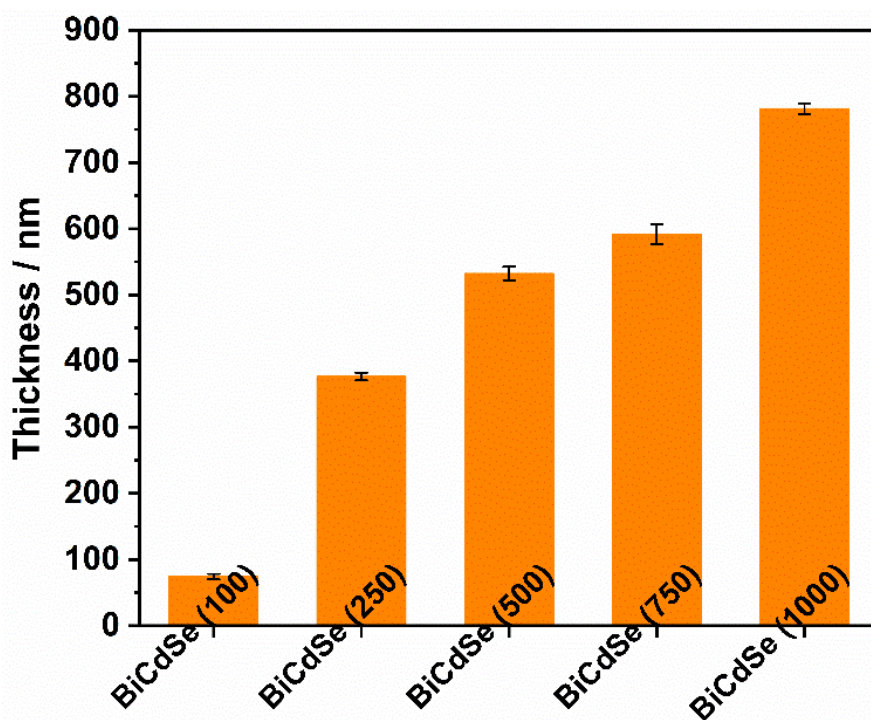


Fig. S2. Thickness profile of the composite BiCdSe films.

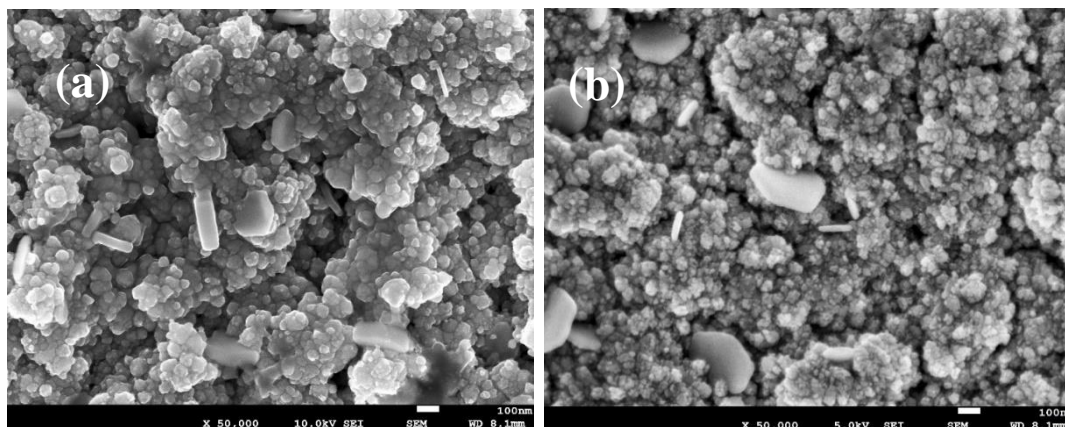


Fig. S3. Typical FESEM images of BiCdSe developed under (a) 250 and (b) 750 cycles.

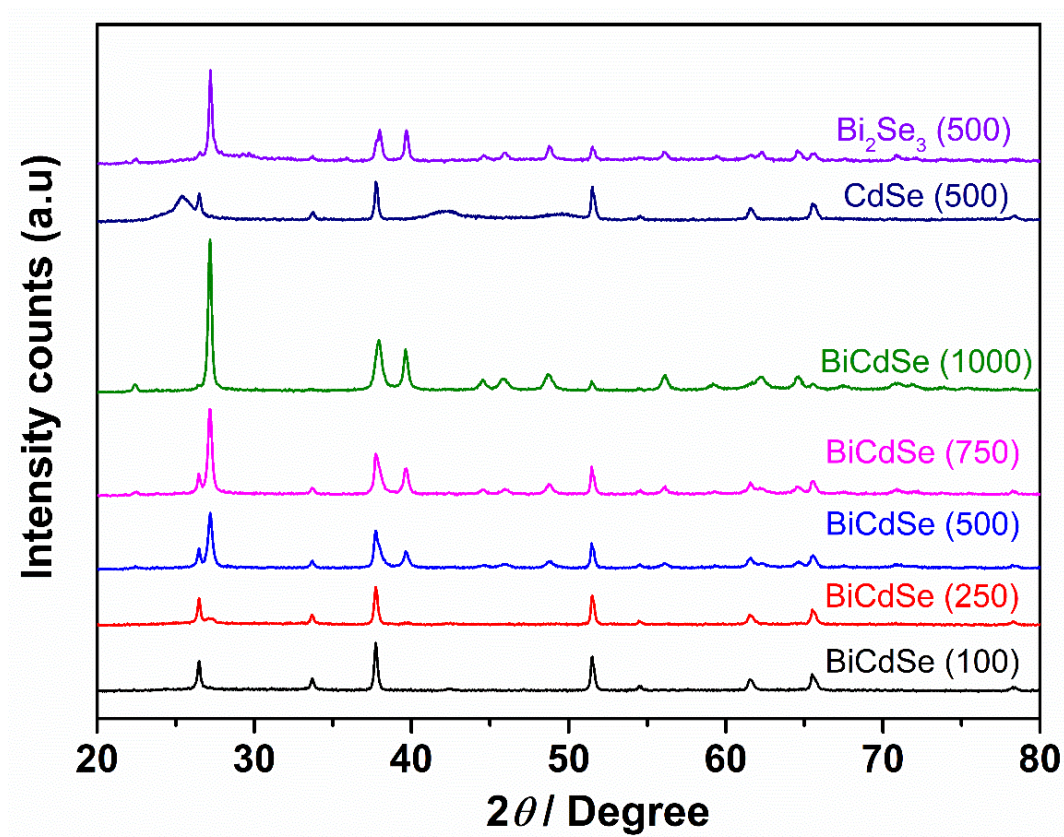


Fig. S4. XRD patterns of all the composite BiCdSe films and CdSe, Bi₂Se₃ films deposited under 500 cycles.

Table S1. EIS records of electrochemically deposited films.

SC Materials	R_{ct} / Ω	CPE / $\mu\text{F cm}^{-2}$	$N_D \times 10^{-21}$ / cm^{-3}	V_{fb} (vs SCE)/V
CdSe (500)	320	6.8	0.02	-2.018
BiCdSe (100)	810	222.0	2.36	-0.225
BiCdSe (250)	231	531.0	9.07	-0.462
BiCdSe (500)	145	762.6	20.13	-0.514
BiCdSe (750)	568	784.6	3.97	-0.449
BiCdSe (1000)	885	206.4	0.50	-0.363
Bi ₂ Se ₃ (500)	410	528.0	0.46	-0.932

Table S2. Potentiodynamic Polarization and ASV parameters for the deposited films.

SC Materials	$i_{corr} \times 10^5$ / A cm^{-2}	E_{corr} / V	$r_{corr} \times 10^{11}$ / $\text{kgcm}^{-2}\text{s}^{-1}$	VA analysis results / ppm	
				Estimated [Cd ²⁺]	Estimated [Bi ³⁺]
CdSe (500)	0.07	-0.028	0.07	0.19	-
BiCdSe (100)	0.97	-0.413	0.81	0.12	3.39
BiCdSe (250)	1.02	-0.481	0.86	0.19	5.73
BiCdSe (500)	2.19	-0.426	1.85	0.42	8.91
BiCdSe (750)	2.71	-0.446	2.29	1.21	20.29
BiCdSe (1000)	5.03	-0.471	4.23	1.38	29.06
Bi ₂ Se ₃ (500)	11.12	-0.507	12.58	-	31.01

Table S3. *J-V* characteristics of electrochemically deposited semiconductor films.

SC Materials	$J_{sc} / \text{mA cm}^{-2}$	$\% \eta$	$\% FF$
Bi ₂ Se ₃ (500)	6.77	1.24	13.81
BiCdSe (100)	2.42	0.85	25.31
BiCdSe (250)	4.71	1.78	25.95
BiCdSe (500)	5.58	2.57	32.98
BiCdSe (750)	3.38	0.79	20.35
BiCdSe (1000)	2.62	0.65	18.83
CdSe (500)	1.52	0.36	16.88