Electronic Supplementary Information for

Controllable Growth of Ni_xCo_ySe Films and the Composition Influence on the Photovoltaic Performance of Quasi-Solid-State Dye-Sensitized Solar Cells

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Table S1. The power conversion efficiency of DSSCs with multinary metal selenides CEs reported in the literatures.

CEs	Morphology	Liquid electrolyte	PCE/%(Pt)	Ref.
Cu_2SnSe_3	Nanoparticles	I^-/I_3^-	7.75(7.21)	26
$Ni_{0.9}Sn_{0.1}Se_2$	Nanoparticles	I^-/I_3^-	4.20(6.11)	27
$Ni_{0.5}Co_{0.5}Se$	Nanocrystals	I^-/I_3^-	6.02(6.11)	28
$Ni_{0.33}Co_{0.67}Se$	Dandelion-like microspheres	I^-/I_3^-	9.01(8.30)	29
$Co_{0.42}Ni_{0.58}Se$	Nanosheets and nanoparticles	I^-/I_3^-	6.15(5.53)	30
NiCoSe	Hollow microspheres	I^-/I_3^-	9.04(8.07)	31
$Cu_2ZnSnSe_4$	Nanoparticles	I^-/I_3^-	3.85(4.03)	32
$Cu_2ZnSnSe_4$	Nanocrystal	I^-/I_3^-	7.82(7.56)	33
$Cu_2ZnSnSe_4$	Nanocrystals	I^-/I_3^-	7.06(7.43)	34
CuCoSe	Nanosheets	I^-/I_3^-	7.81	35
CuFeSe		I^-/I_3^-	7.22	35

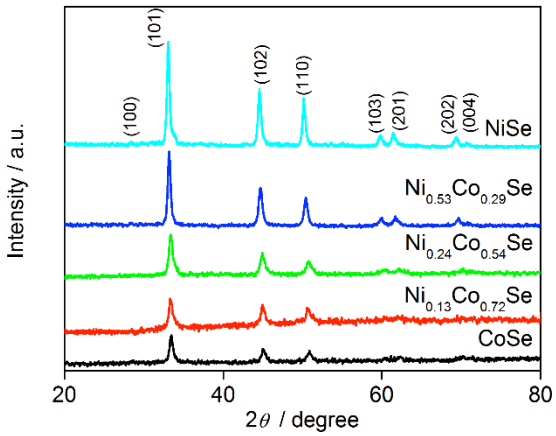

Figure S1. XRD patterns of the precipitate samples.

Table S2. Element ratio (Ni:Co:Se) of as-prepared samples

Feed ratio (Ni:Co:Se)	Ni:Co:Se (Precipitate samples)	Ni:Co:Se In-situ-growth films
0.5:2.5:4	0.13:0.72:1	0.07:0.91:1
1:2:4	0.24:0.54:1	0.12:0.80:1
2:1:4	0.53:0.29:1	0.29:0.63:1

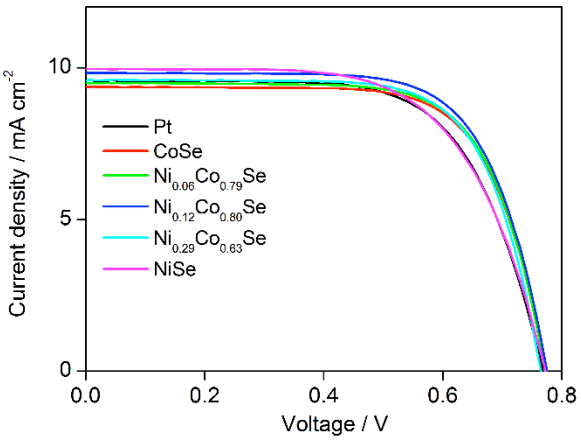

Figure S2. *J–V* curves of QSDSSCs with Pt, CoSe, NiSe and Ni_xCo_ySe CEs using 5 μm thick TiO_2 films.

Table S3. Photovoltaic performance parameters of QSDSSCs with various CEs using 5 μm thick TiO_2 films.

CE	V_{oc} / mV	J_{sc} / mA cm^{-2}	FF	PCE / %
Pt	767	9.58	0.66	4.87
CoSe	772	9.36	0.7	5.11
$Ni_{0.07}Co_{0.91}Se$	771	9.50	0.71	5.16
$Ni_{0.12}Co_{0.80}Se$	775	9.83	0.71	5.32
$Ni_{0.29}Co_{0.63}Se$	764	9.60	0.70	5.17
NiSe	771	9.95	0.64	4.88

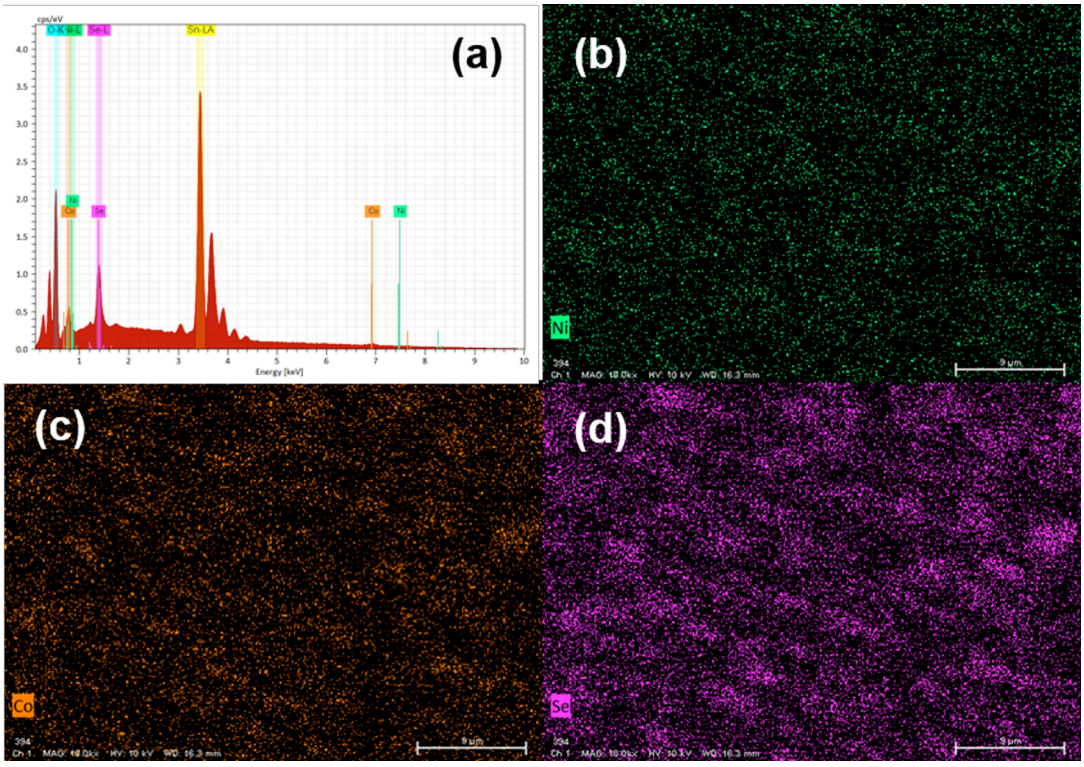

Figure S3. EDS spectrum (a) for $Ni_{0.12}Co_{0.80}Se$ nanoparticles on FTO and SEM-EDS elemental mapping of Ni (b), Co (c), Se (d).

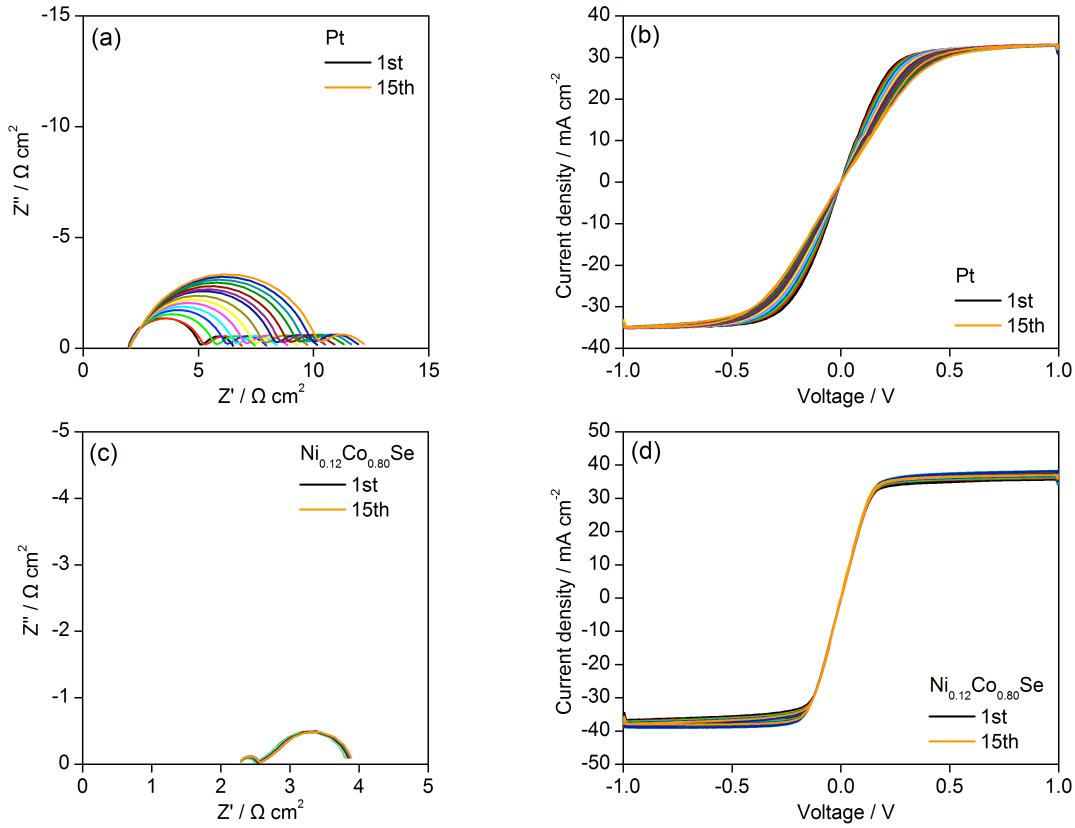

Figure S4. Nyquist plots of EIS and CV plots for the symmetrical cells with Pt (a, b) and $Ni_{0.12}Co_{0.80}Se$ (c, d) CEs, respectively. The cell was first subjected to CV scanning from 0 to 1 V and then from −1 to 0 V with a scan rate of 100 mV s^{-1}, followed by 20 s relaxation at 0 V, and then EIS measurement at 0 V from 0.1 Hz to 300 kHz was performed. This sequential electrochemical test was repeated for 15 times.

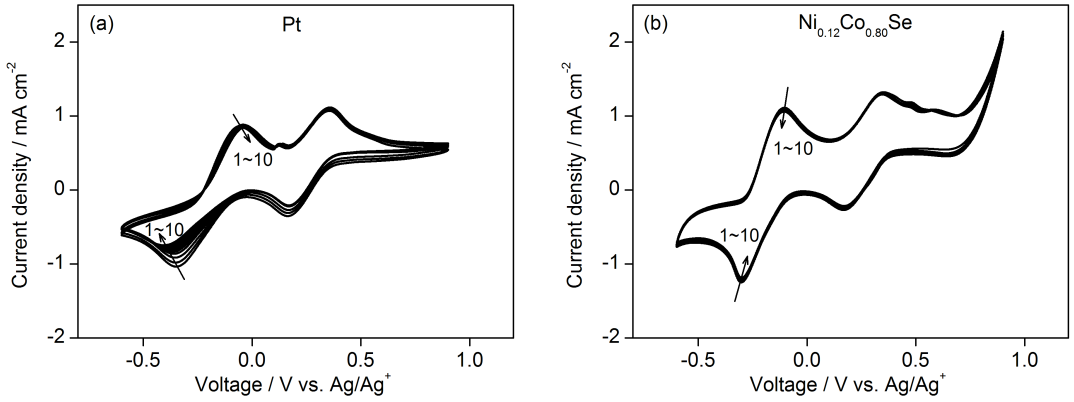

Figure S5. 10-cycle CV curves of (a) Pt and (b) $Ni_{0.12}Co_{0.80}Se$ electrodes in the acetonitrile electrolyte containing 0.1 M $LiClO_4$, 10 mM LiI, and 1 mM I_2 for the three-electrode configuration.