

Supporting Information for

**Achieving High Performance And Stable Inverted Planar Perovskite Solar Cells
By Using Lithium and Cobalt Codoped Nickel Oxide As Hole Transport Layer**

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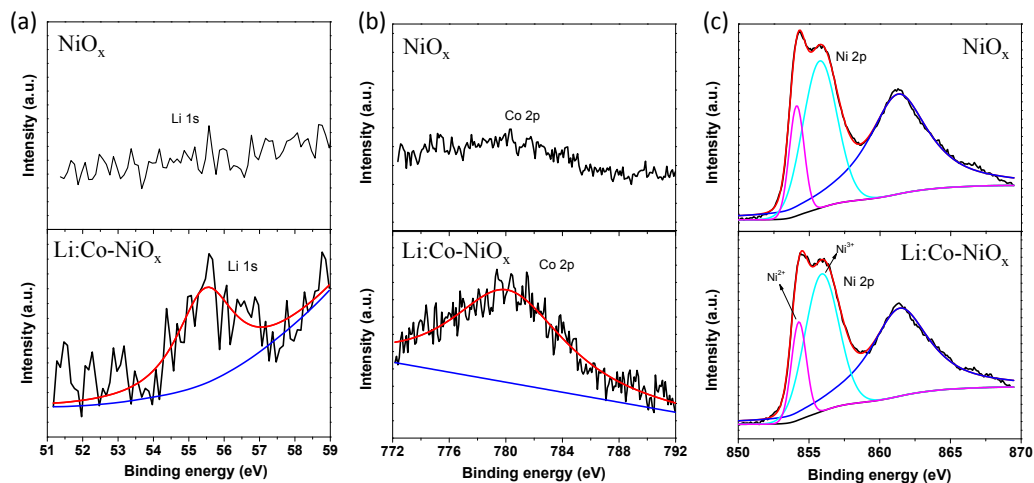


Figure S1. XPS spectra of Li 1s (a), Co 2p_{3/2} (b), and Ni 2p_{3/2} (c) peaks based on NiO_x and Li and Co co-doped NiO_x.

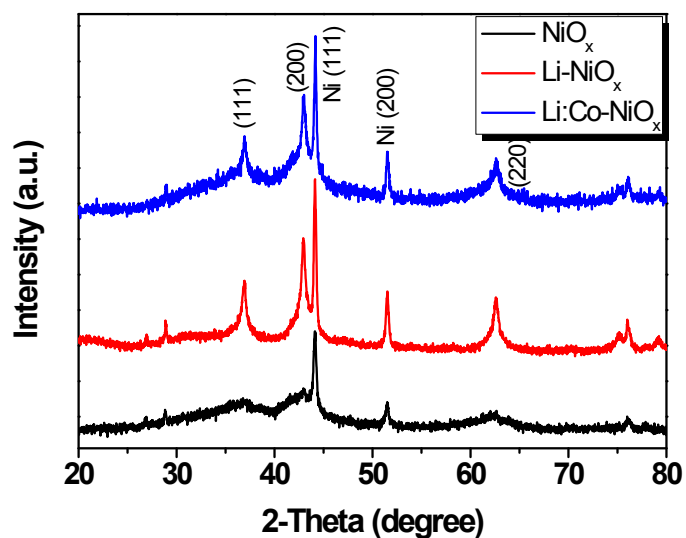


Figure S2. (a) Powder X-ray diffraction spectra of pristine NiO_x, 10 % Li doped NiO_x, 10 % Li and 5 % Co co-doped NiO_x.

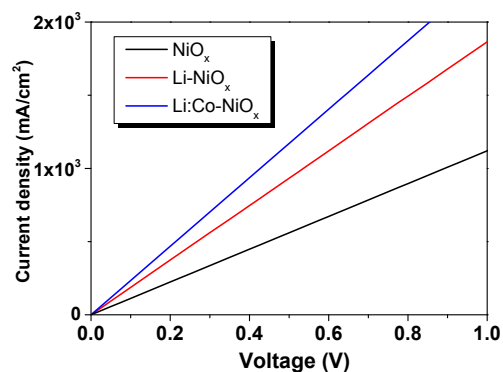


Figure S3. The conductivity $I - V$ curves of different HTLs with different doping conditions.

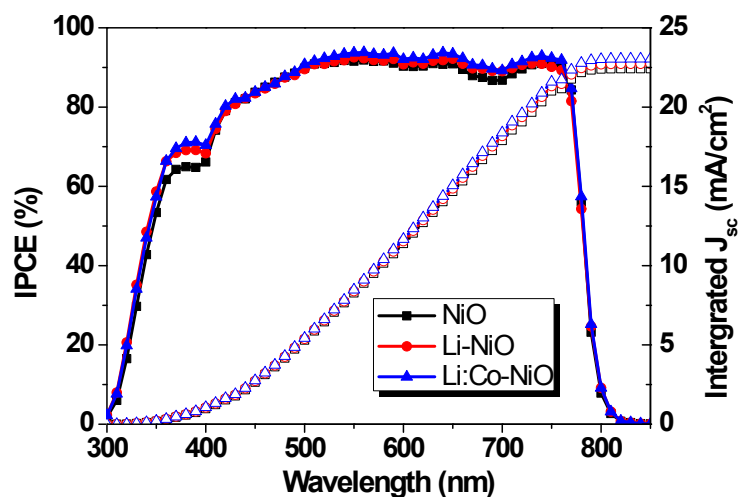


Figure S4. The IPCE spectra and integrated photocurrents of the devices.

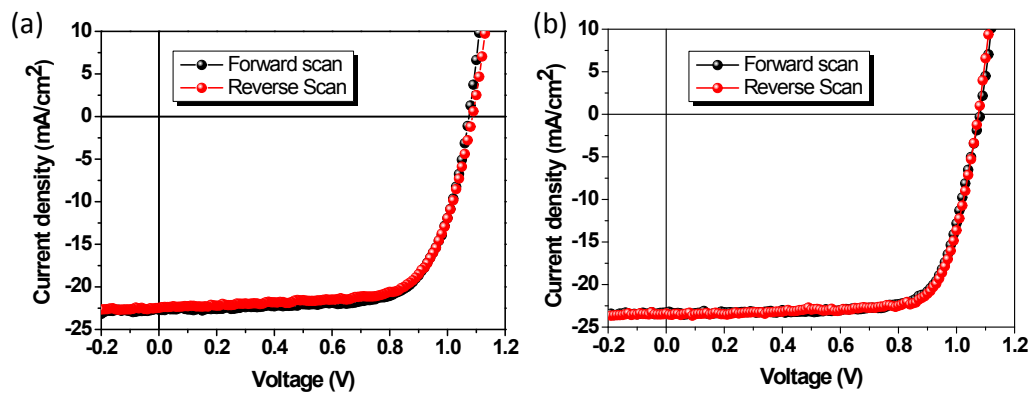


Figure S5. $J - V$ curves of PSCs based on (a) pristine NiO_x and (b) Li doped NiO_x

measured under different scan directions.

Table S1. Photovoltaic parameters of planar heterojunction PSCs with different doping conditions.

condition	J_{sc} (mA/cm ²)	V_{oc} (V)	FF	PCE (%)
pristine	22.7±0.8	1.05±0.02	0.73±0.03	17.4±0.7
10% Li	23.2±0.6	1.07±0.02	0.76±0.02	18.8±0.5
10% Li+5% Co	23.7±0.5	1.08±0.01	0.76±0.02	19.5±0.5
10% Li+5% Co	23.8±0.5	1.09±0.01	0.78±0.02	20.1±0.3
10% Li+10% Co	21.9±0.8	0.92±0.05	0.62±0.05	12.6±0.6

Table S2. Fitted decay times of perovskite thin films deposited on different hole transporting layers.

HTL	Fraction 1	τ_1 (ns)	Fraction 2	τ_2 (ns)	τ_{ave} (ns)
NiO _x	0.05	5.80	0.95	70.70	67.46
Li-NiO _x	0.06	3.20	0.94	61.45	57.96
Li:Co-NiO _x	0.06	2.33	0.94	44.22	41.71