Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.

Supporting Information for

Solid-state p-n tandem dye-sensitized solar cell

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1. Device structure during fabrication

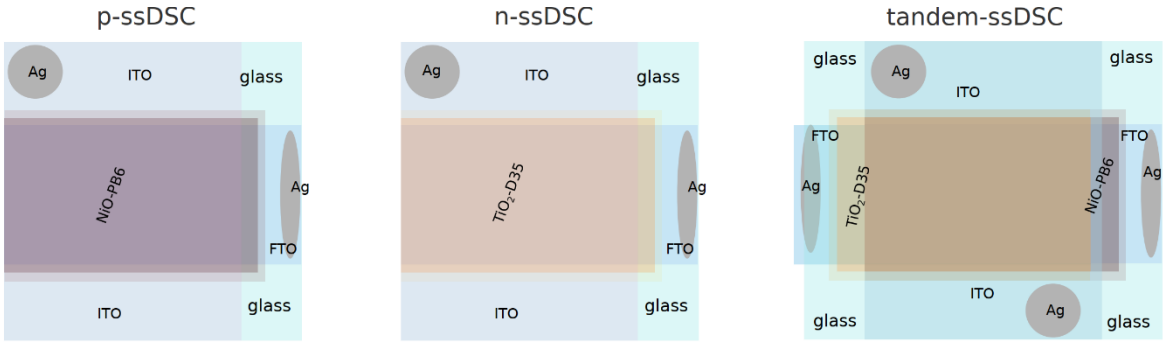

Figure S1: Device structure of p-ssDSC, n-ssDSC and resulting tandem device.

2. Summary of the field of p-ssDSCs

Table S1: Comparative analysis of existing studies of p-ssDSCs

p-type Semiconductor	**Dye**	**ETM**	**Counter Electrode**	**V_{oc} (mV)**	**J_{sc} (µA/cm^2)**	**Ref**
NiO from screen printing paste	P1	PCBM	Al	620	50	1
NiO from $NiCl_2$ gel	PB6	TiO_2	Au	480	23	2
NiO from screen printing paste	PB6	ZnO	Al	440	680	3
NiO from screen printing paste	TIP	ZnO	Al	535	860	4
NiO from screen printing paste	TIP	SnO_2	Al	269	1140	5
NiO from screen printing paste	PB6	SnO_2	Al	199	1082	5
NiO from paste via spin-coating	DPP-PYRO	PCBM	Al	325	225	6
NiO from screen printing paste	PB6	ZnO	ITO	407	890	This work

3. Extra spin-coating layer is beneficial in addition to aging the cells.

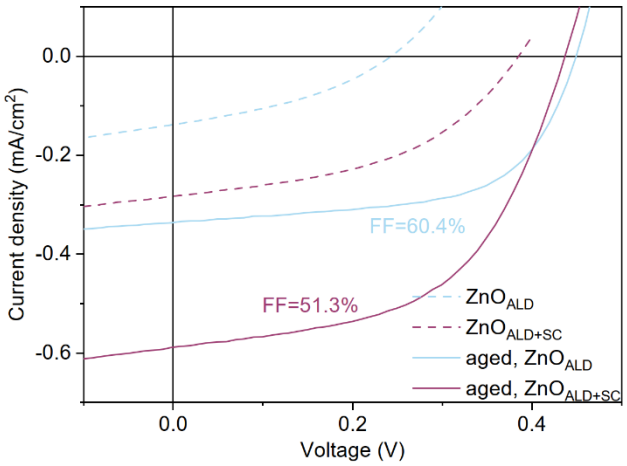

Figure S2: *J-V* curves of p-ssDSC with just an ALD layer of ZnO and an extra layer of solution processed ZnO from $Zn(acac)_2$ solution, both directly after fabrication and after aging for 8 weeks.

4. Thickness optimization of n-ssDSC without or with PB6 cover to match the current of p-ssDSC

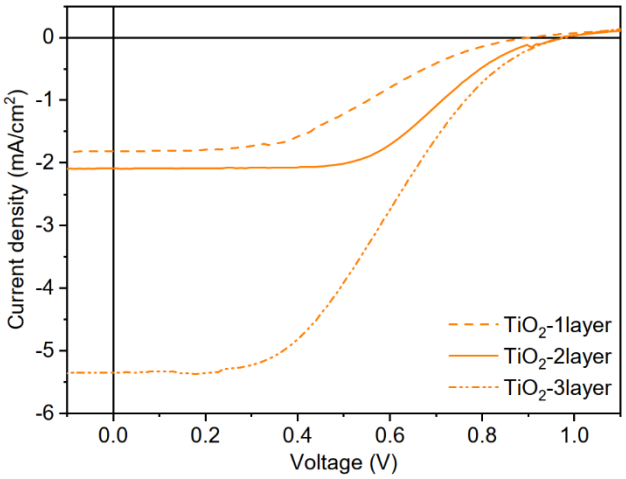

Figure S3: *J-V* curves of n-ssDSCs fabricated with 1, 2 and 3 layers of TiO_2, illuminated from the ITO, without PB6 cover.

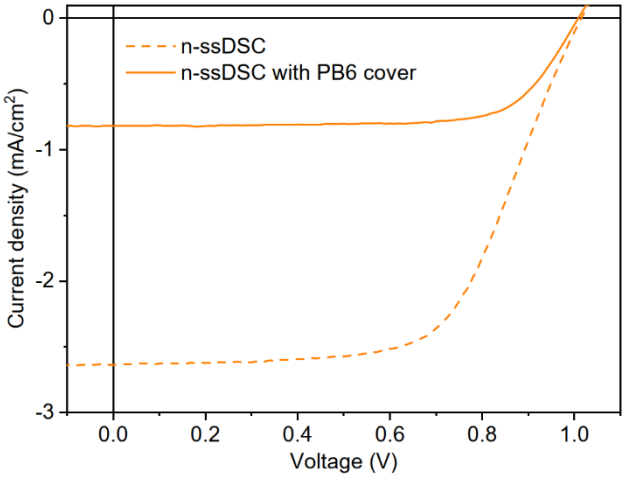

Figure S4: *J-V* curves of n-ssDSCs fabricated with 2 layers of TiO_2, illuminated from the ITO side, with and without PB6 cover.

5. SEM of n-ssDSC and p-ssDSC

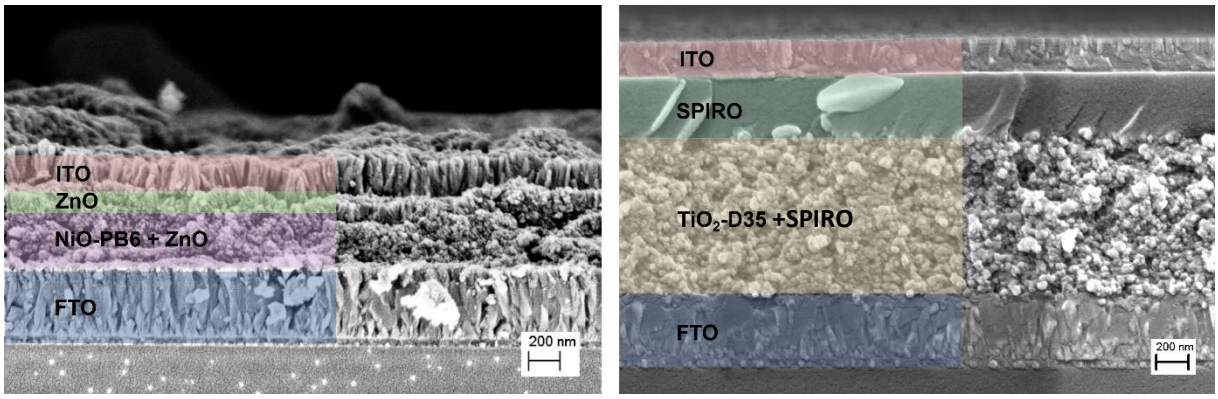

Figure S5: SEM cross-section pictures of (left) n-ssDSC and (right) p-ssDSC.

6. IPCE of fabricated devices

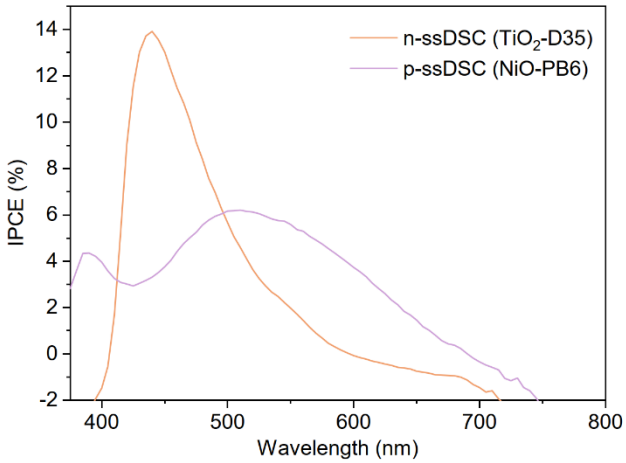

Figure S6: Recorded IPCE spectra of p-ssDSC and n-ssDSC.

7. Stability of the fabricated solar cells

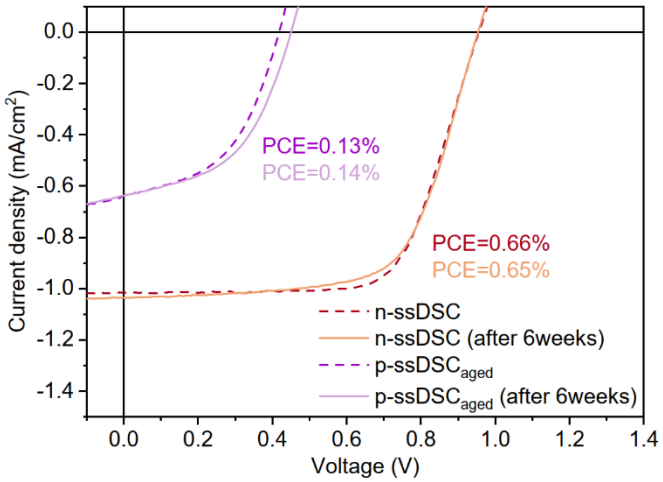

Figure S7: *J-V* curves of two ss-DSCs from Fig. 5 in the main text after storage in ambient conditions for 6 weeks. Note that the p-ssDSC is already aged at the starting point and that p-ssDSC is measured by illumination from the FTO side and that the n-ssDSC was shaded by a p-ssDSC during the measurement.

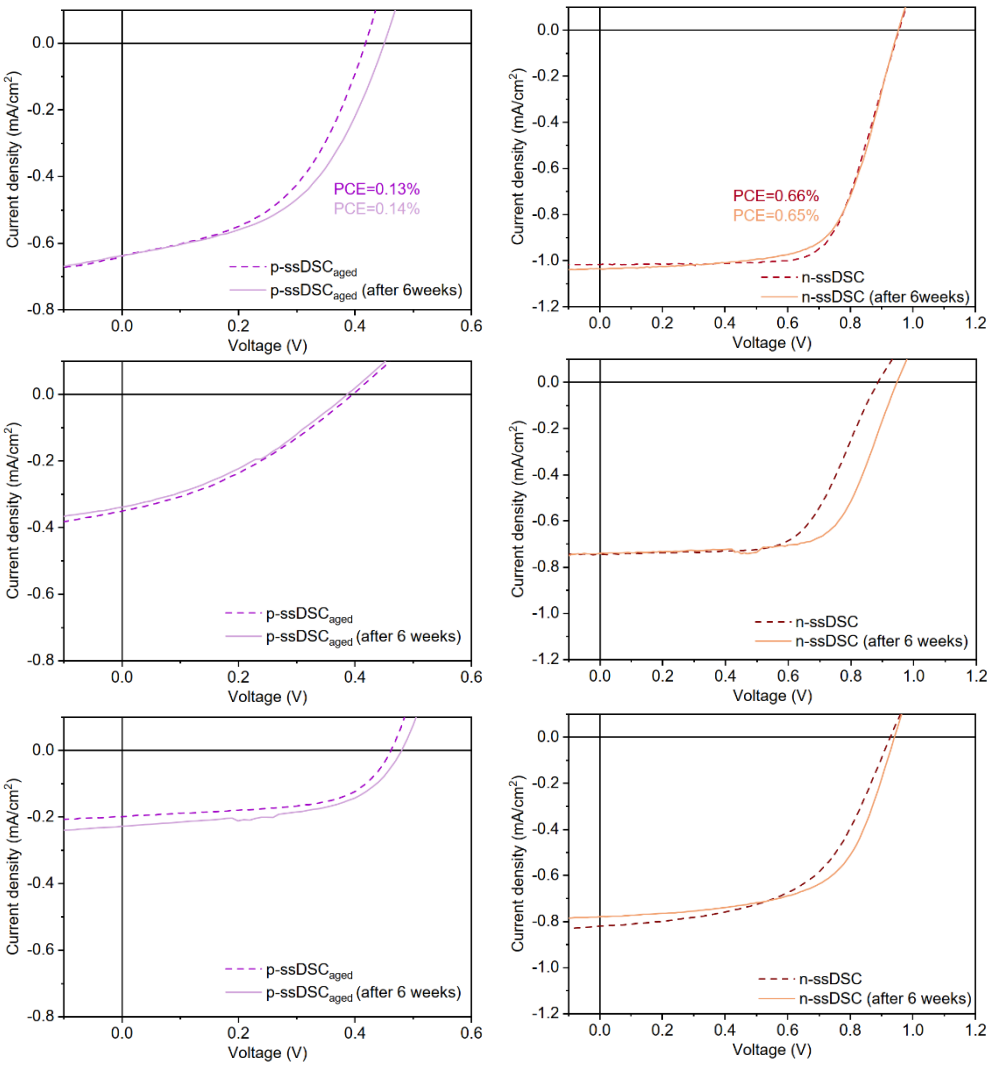

Figure S8: J-V curves of three p-ssDSC (left) and p-ssDSC films (right) from Fig. 5 in the main text after storage in ambient conditions for 6 weeks. Note that the p-ssDSC is already aged at the starting point and that p-ssDSC is measured by illumination from the FTO side and that the n-ssDSC was shaded by a p-ssDSC during the measurement.

References

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