High efficiency organic-silicon heterojunction solar cells with high work function PEDOT:F-based hole-selective contacts

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Support Information

Table S1 The J-V parameters of selected high efficiency organic/c-Si heterojunction solar cells

Contact Types	V_{oc}/mV	J_{sc}/mA·cm^{-2}	FF/%	PCE/%
b-PEI[1]	720	37.0	72.9	19.4
Ill-PEI[2]	641	37.6	80.7	19.5
PCBM[3]	706	40.67	77.1	20.0
PTAA[4]	634	39.1	80.6	20.2
PEDTOT:PSS[5]	657	38.9	80.6	20.6
2PACZ[6]	725	39.3	79.2	21.4
PEDOT:F	654.8	39.7	83.0	21.6

Table S2 The thickness of spin-coated PEDOT:F films as a function of the concentration (PEDOT:F/ethanol ratio).

PEDOT:F concentration	0.1	0.2	0.3	0.4	0.5
Thickness (nm)	4.2	18.4	21.7	33.3	42.3

Table S3 The main parameters used in the Quokka simulations

Parameters	Value
Cell thickness	160 μm
Front sheet resistance	100 Ω/□
Unit cell dimension	700*700 μm
Junction depth	0.5 μm
Collection efficiency (emitter & rear)	1
J_{0e}-passivated	10 fA/cm^2
J_{0e}-contacted	500 fA/cm^2
Front contact resistivity	1×10^{-4} Ω·cm^2
Front contact shape/half width	line /12.5 μm
p^+ emitter half width	700 μm
p-Si bulk resistivity	3.0 Ω·cm
Bulk lifetime	3000 μs
Rear contact shape	full area
Rear contact J_0 sweep range	1×10^{-15} to 1×10^{-11}A/cm^2
Rear contact ρ_c sweep range	1×10^{-3} to 10 Ω·cm^2
Generation type	uniform
Generation current	44 mA/cm^2
Illumination side	Front
Shading width	25 μm

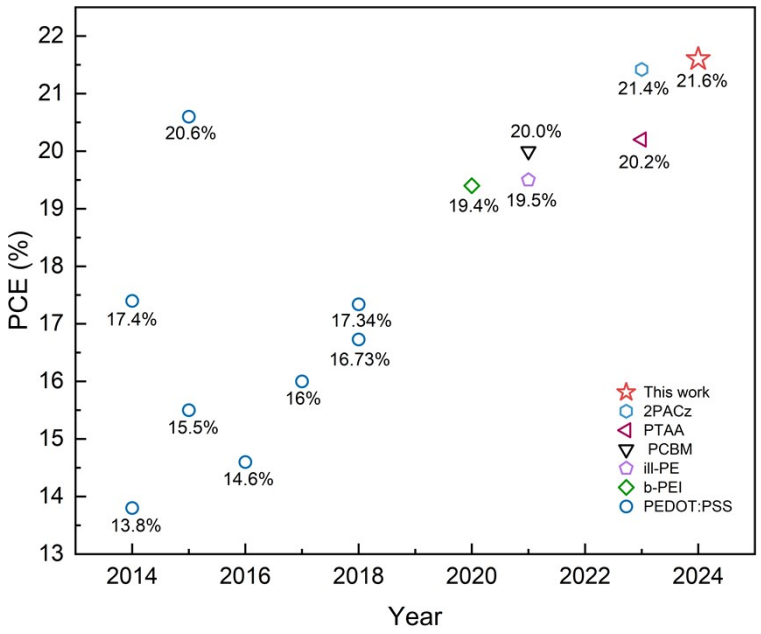

Figure S1. The PCE evolution of organic/c-Si heterojunction solar cells

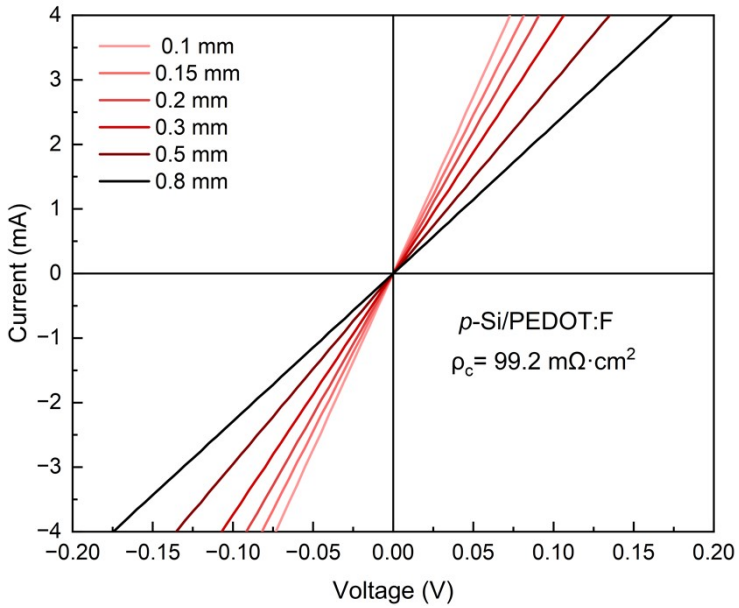

Figure S2. Dark *I-V* curves of *p*-Si/PEDOT:F/Ag heterocontact measured under different spacings, and the extracted ρ_c is shown together.

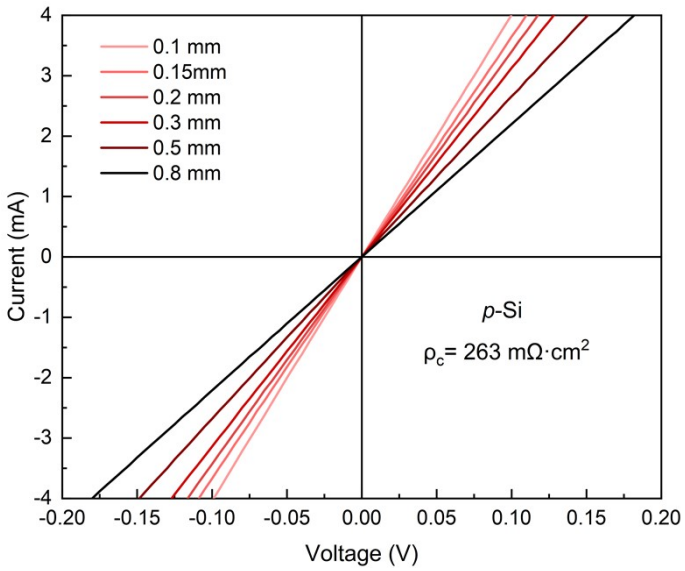

Figure S3. Dark *I-V* curves of *p*-Si/Ag direct contact measured under different spacings, and the extracted ρ_c is shown together.

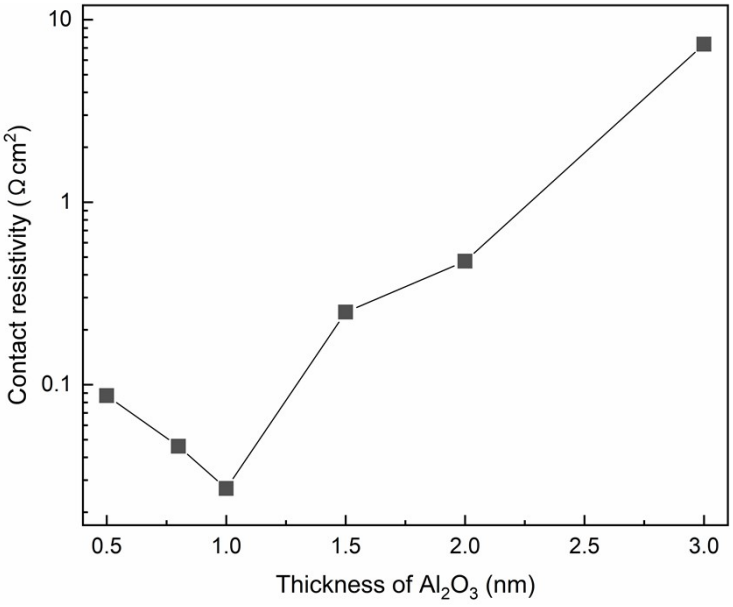

Figure S4. The contact resistivity of *p*-Si/Al_2O_3/PEDOT:F/Ag heterocontact with different thickness of Al_2O_3.

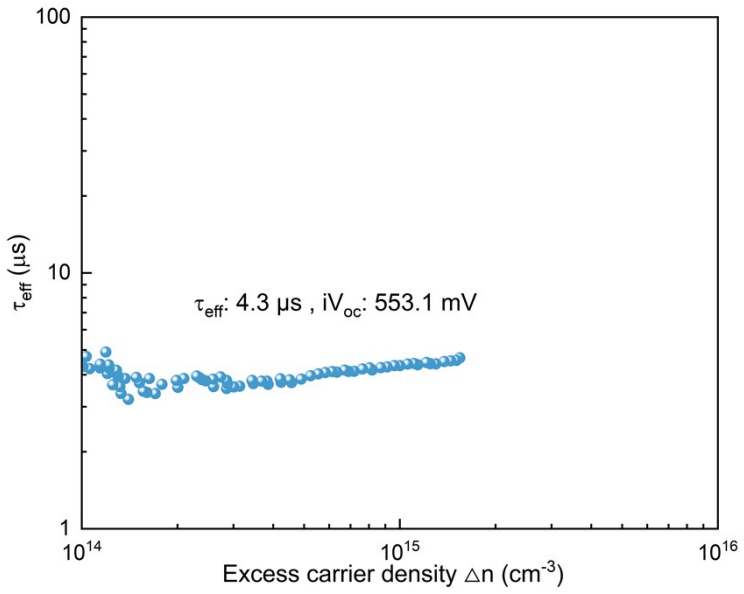

Figure S5. Injection level-dependent minority carrier lifetime of bare *p*-Si.

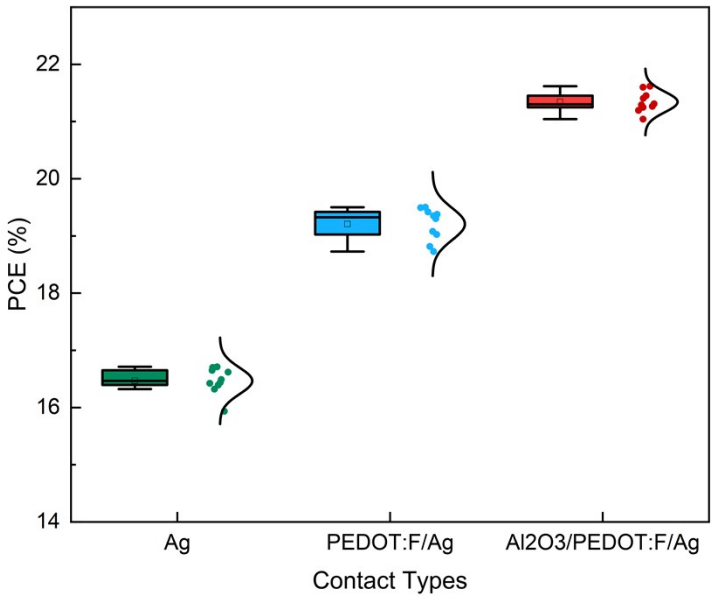

Figure S6. Efficiency distribution of p-Si solar cells with different rear contacts

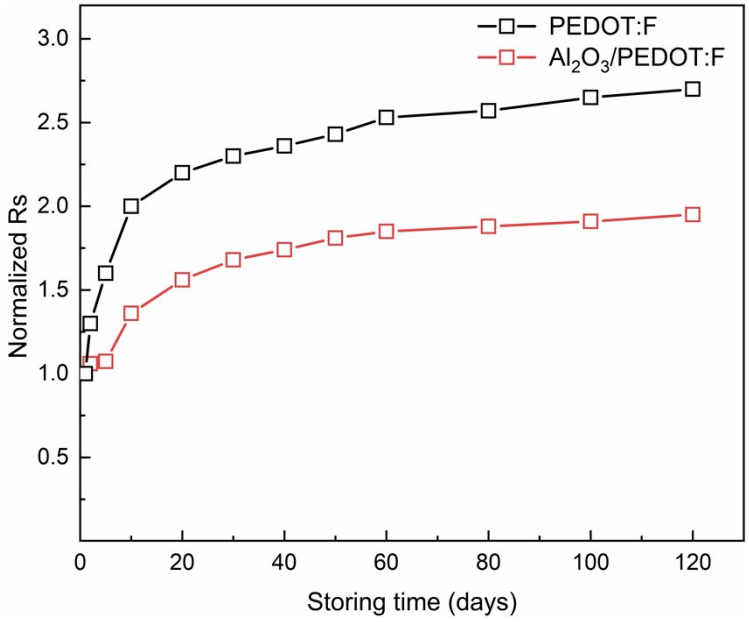

Figure S7. Dependence of normalized series resistance (R_s) of *p*-Si solar cells with PEDOT:F and Al_2O_3/PEDOT:F rear contacts on the storing times.

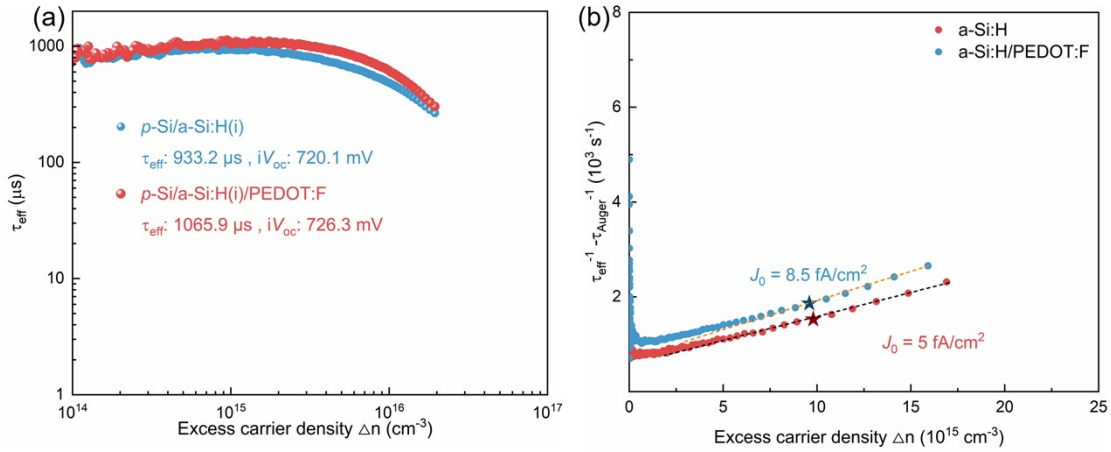

Figure S8. (a) Injection level-dependent minority carrier lifetime and (b) (τ_{eff}^{-1} -τ_{Auger}^{-1}) of *p*-Si passivated by a-Si:H and a-Si:H/PEDOT:F stack. The τ_{eff}, iV_{oc} and J_0 are extracted and shown together.

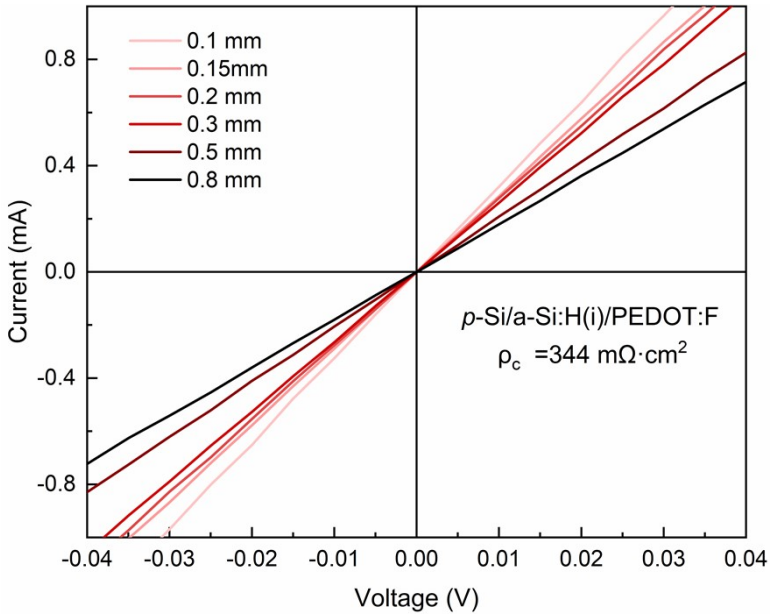

Figure S9. Dark *I-V* curves of *p*-Si/a-Si:H/PEDOT:F/Ag heterocontact measured under different spacings, and the ρ_c is extracted and shown together.

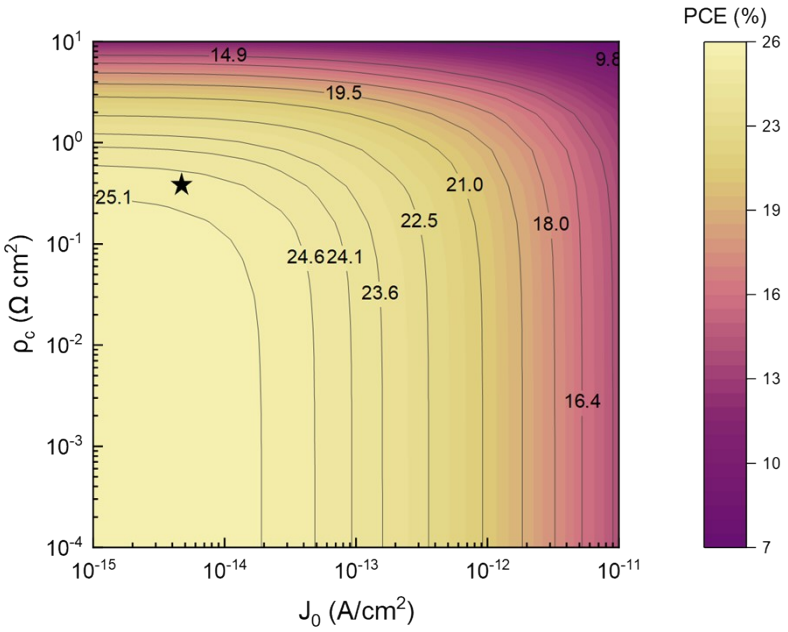

Figure S10. Dependence of the PCE of *p*-Si solar cells on J_0 and ρ_c of the a-Si/PEDOT:F rear contact calculated using Quokka 2. The potential PCE of device is marked with a star.

References

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