Supporting Information for

Inverse-Architecture Perovskite Solar Cells with 5,6,11,12-tetraphenylnaphthacene as a Hole Conductor

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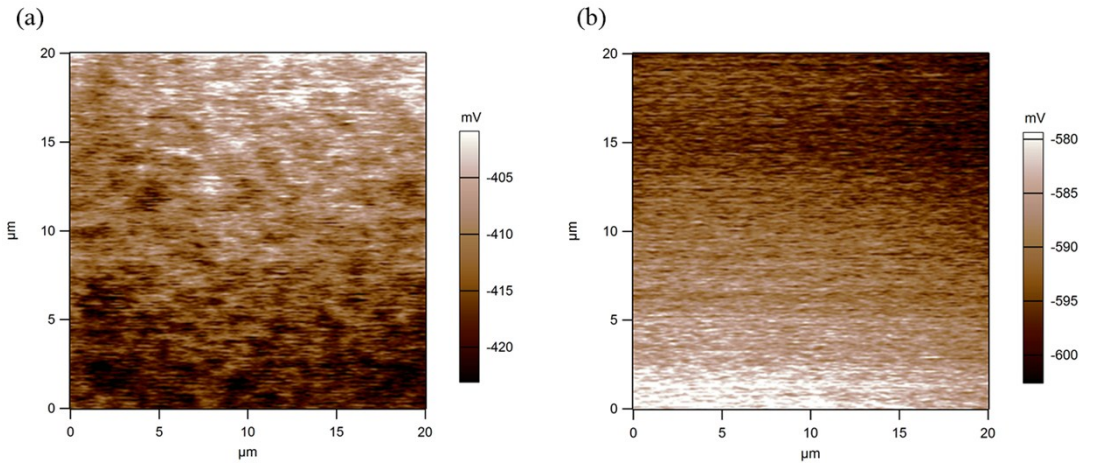

Fig. S1 Two-dimensional surface potential distributions of (a) PEDOT:PSS and (b) rub films. The average values of the contact potential difference between sample and the probe are -412 and -594 mV for PEDOT:PSS and rub, respectively.

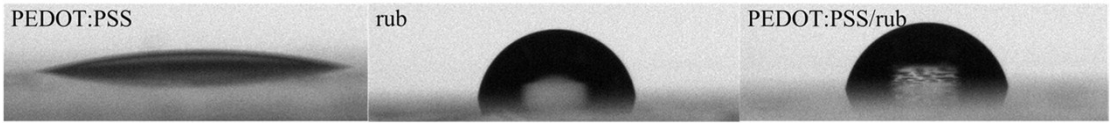

Fig. S2 Photographs of the contact angle for the PEDOT:PSS, rub and PEDOT:PSS/rub substrate. The water contact angle for PEDOT:PSS, rub and PEDOT:PSS/rub are 9.5°, 80.3° and 77.2°, respectively.

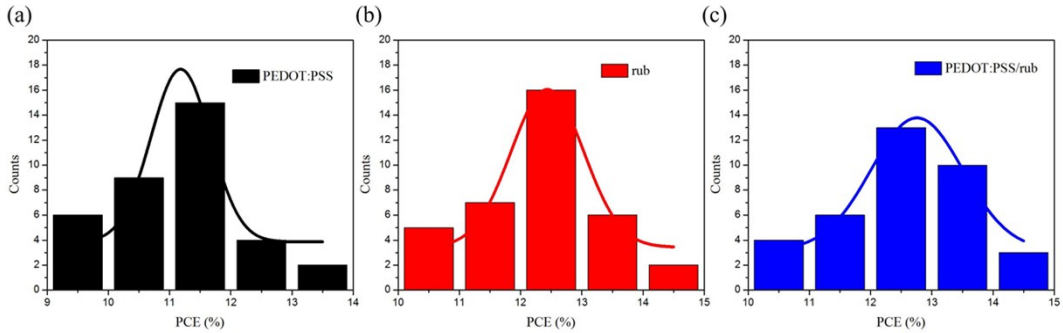

Fig. S3 Histogram of solar cell efficiencies for 36 devices with (a) PEDOT:PSS, (b) rub, (c) PEDOT:PSS/rub as HTL, respectively. Black, red and blue solid lines represent the Gaussian distribution fitting for the statistics on efficiencies. The PCE mean values of Gauss distribution are 11.5%, 12.4%, 12.8% for PEDOT:PSS, rub and PEDOT:PSS/rub hole transport layer, respectively.

Table S1 The calculated surface potential of PEDOT:PSS and rub with scanning Kelvin probe microscope. The formula is $\varphi_s = \varphi_{Tip} + e \cdot V_{CPD}$, of which φ_s is surface potential of sample, φ_{Tip} is the tip potential of yttrium probe, and V_{CPD} is the contact potential difference between sample and the probe.

sample	φ_{Tip} (eV)	V_{CPD} (V)	φ_s (eV)
PEDOT:PSS	-4.47	-0.412	-4.88
rub	-4.47	-0.594	-5.06

Table S2 Summarized PL lifetimes of perovskite layer on the hole transport layer of PEDOT:PSS, rub or PEDOT:PSS/rub. The PL lifetimes were fitted with a bi-exponential decay function including a fast decay (t_1) and a slow decay (t_2) process.

HTL	A_1	t_1 (ns)	A_2	t_2 (ns)
PEDOT:PSS	1.7×10^{13}	0.68	1.6×10^{4}	7.6
rub	8.6×10^{13}	0.63	1.4×10^{4}	6.9
PEDOT:PSS/rub	1.7×10^{13}	0.68	1.7×10^{4}	7.2