SUPPORTING INFORMATION

Phosphonic Acid Modification of the Electron Selective Contact: Interfacial Effects in Perovskite Solar Cells

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Table S1. Work function in eV for control and phosphonic acid modified substrates.

	φ [eV]
Control	4.8 ± 0.1
***p*CN-BPA**	4.5 ± 0.1
BPA	4.3 ± 0.1
DEA-P-CNVPA	4.1 ± 0.1

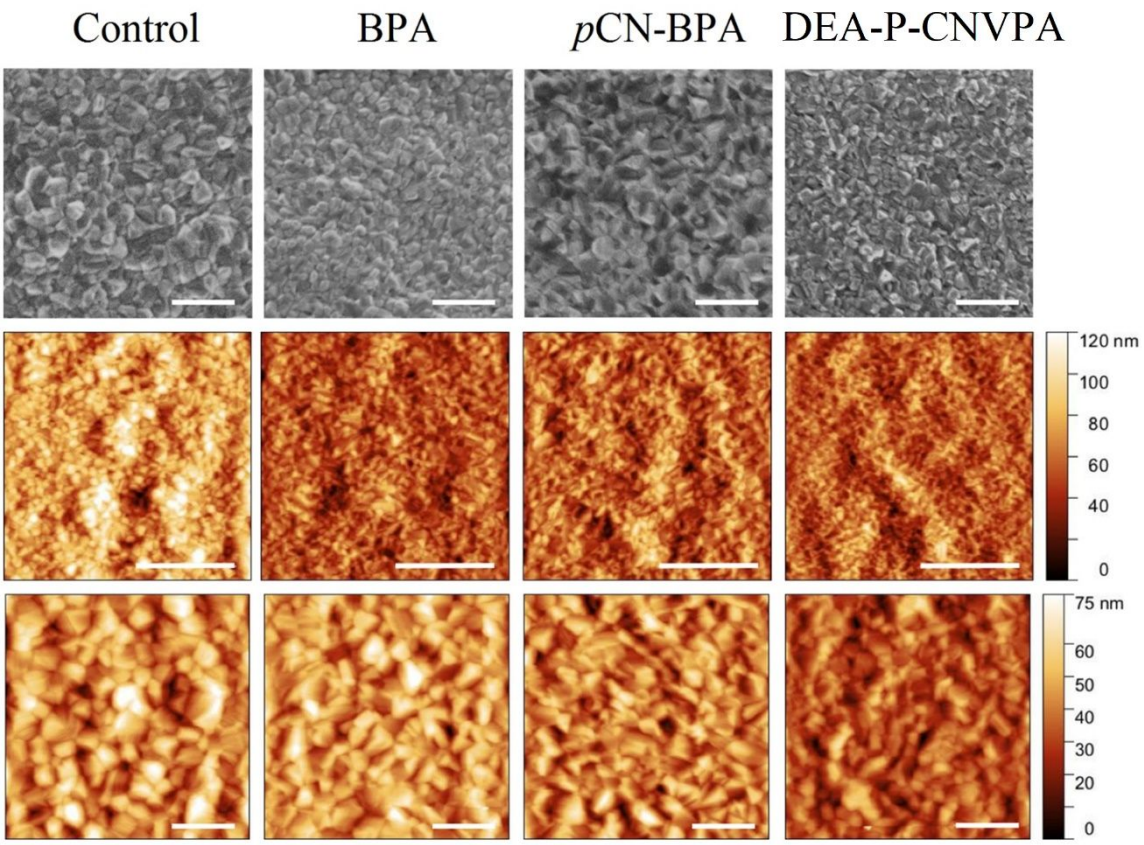

Figure S1. SEM (top row) and AFM (middle and bottom rows) of control and phosphonic acid modified substrates. Prior to device fabrication, the control was treated with UV-Ozone for 15 min, while the tin oxide was modified with 0.05 mM of phosphonic acid in ethanol for 3 h. Scale bar is 500 nm for the top and bottom rows, and 2 µm for the middle row.

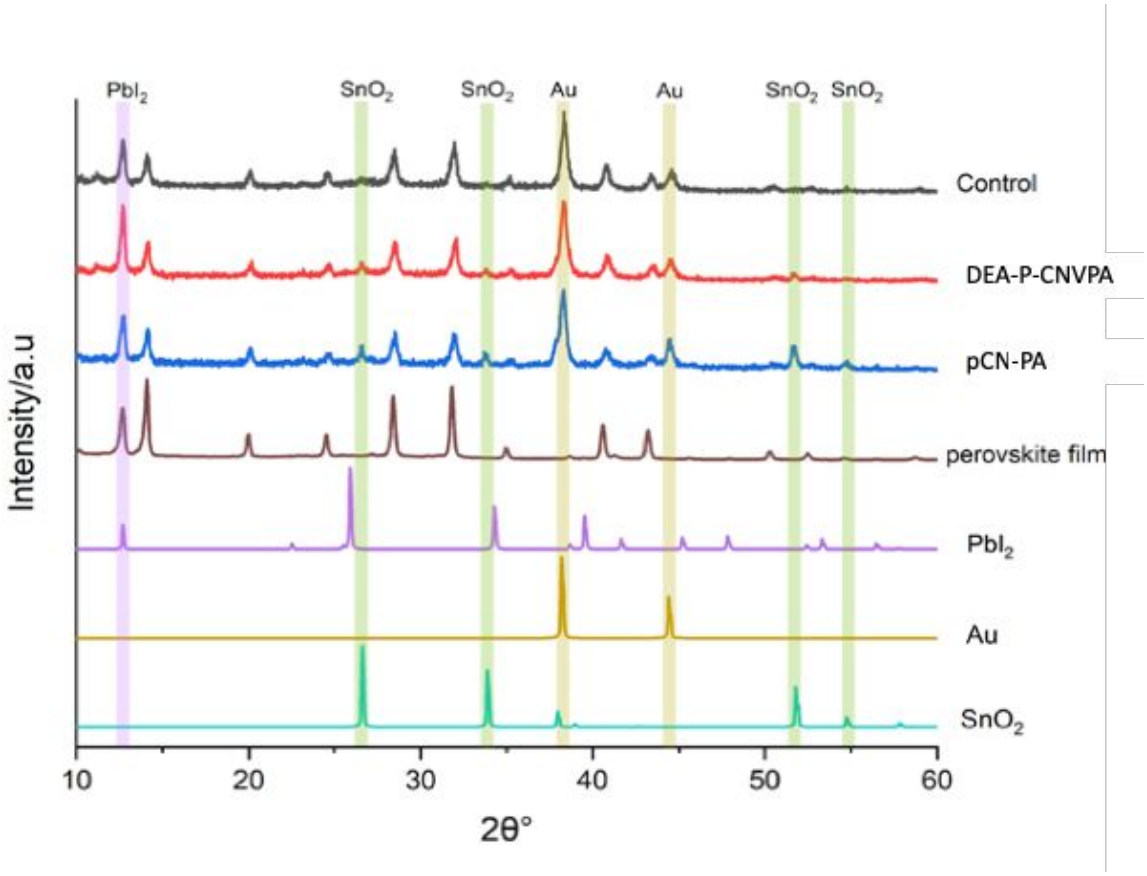

Figure S2. X-ray diffraction patterns of full devices of control, 020A and 038A with reference patterns.

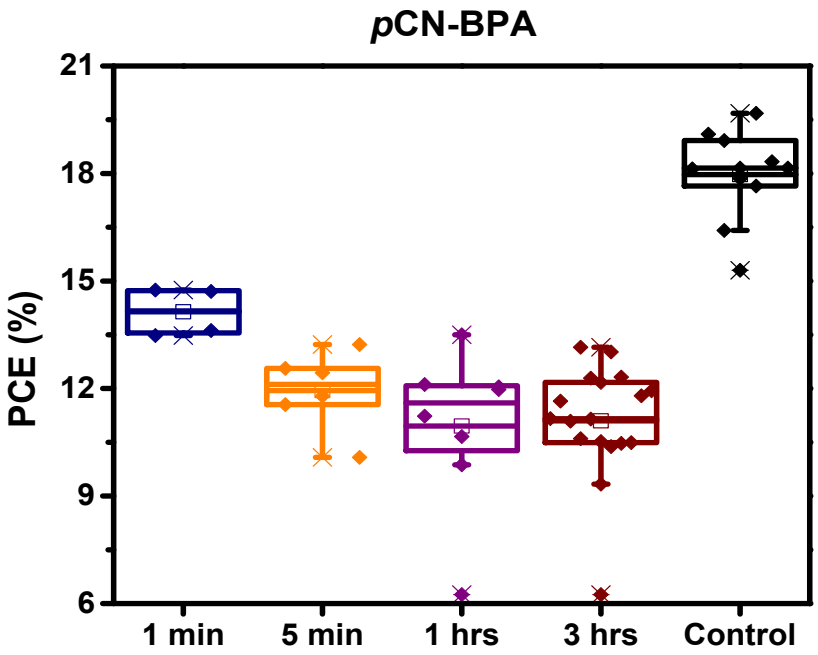

Figure S3. Power conversion efficiency as a function of dipping time for *p*CN-BPA.

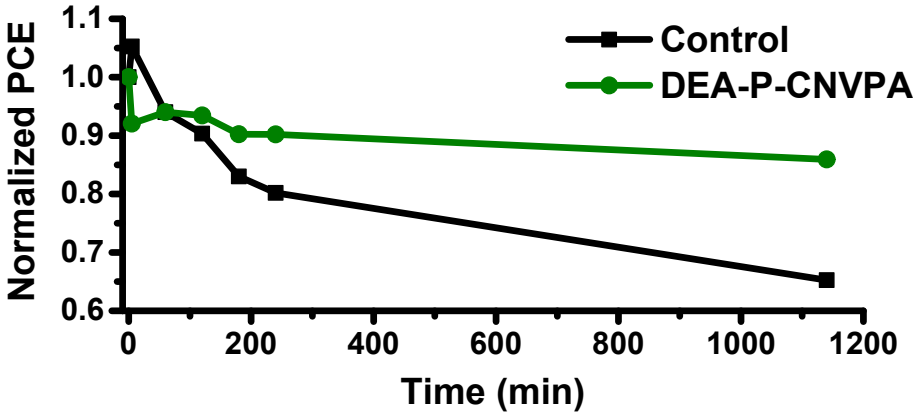

Figure S4. Normalized PCE for control and modified devices as a function of time resting in inert atmosphere. Prior to device fabrication, the control was treated with UV-Ozone for 15 min, while the tin oxide was modified with 0.05 mM DEA-P-CNVPA in ethanol for 1 h.

Table S2. Surface modified[a] tin oxide contact angles using water and diiodomethane, with the calculated dispersive, polar, and total surface energy.[b] The control sample was UV-Ozone treated prior to measurement.

	SnO_2 Control	BPA	*p*CN-BPA	DEA-P-CNVPA
θ_{water} / °	5.4 ± 2.9	27.7 ± 5.3	37.8 ± 3.4	47.9 ± 2.1
$\theta_{diiodomethane}$ / °	29.6 ± 3.8	25.9 ± 3.4	20.3 ± 3.4	21.4 ± 3.4
γ_{polar} / mJ cm^{-2}	31.8 ± 1.1	24.7 ± 2.3	19.0 ± 1.8	14.0 ± 1.2
γ_{disp} / mJ cm^{-2}	44.4 ± 1.6	45.8 ± 1.2	47.7 ± 1.0	47.4 ± 1.1
γ_{total} / mJ cm^{-2}	76.2 ± 1.9	70.5 ± 2.6	66.7 ± 2.1	61.3 ± 1.6

[a]SnO_2 was UV-ozone cleaned and modified by dipping in a 0.05 mM PA sol. in ethanol for 1-3 h and rinsed with EtOH. [b]The surface energy error was propagated from the contact angle measurements and does not include error from literature values.