Supporting information

Enhanced lifetime of polymer solar cells by surface passivation of metal oxide buffer layers

Swaminathan Venkatesan[1,2 ‡], Evan Ngo[1‡], Devendra Khatiwada[1], Cheng Zhang[2] and Qiquan Qiao[*1]

[1] Center for Advanced Photovoltaics, Department of Electrical Engineering and Computer Science, South Dakota State University, Brookings, SD, USA

qiquan.qiao@sdstate.edu

[2] Department of Chemistry and Biochemistry, South Dakota State University, Brookings, SD, USA

[‡] Authors contributed equally to this work

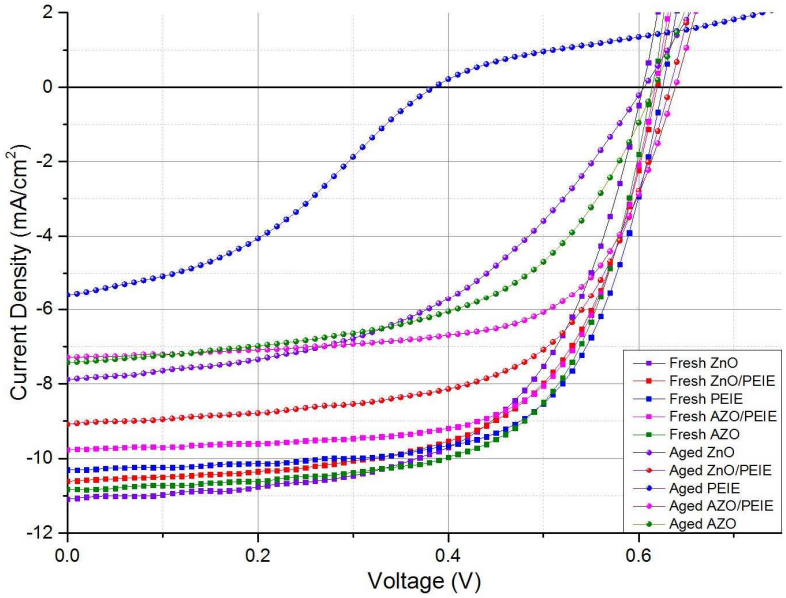

Figure S1 Illuminated current-voltage characteristics for fresh and 6 months aged samples.

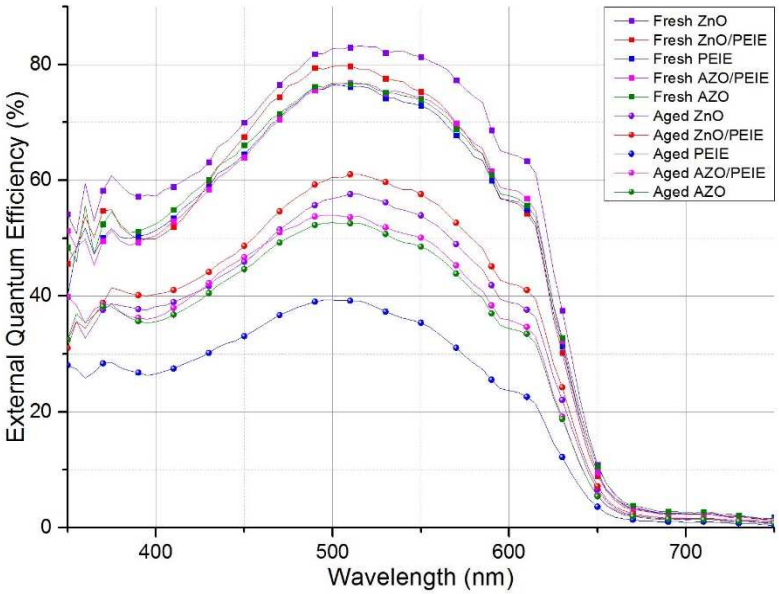

Figure S2 EQE vs. wavelength in nm for fresh and aged P3HT:PCBM devices

Table S1 Comparison of EQE percentages at wavelength 550 nm with Jsc for fresh and 6 months aged devices

	EQE (%)		J_{sc} (mA/cm^2)	
	Fresh	Aged	Fresh	Aged
ZnO	81.31	53.94	11.09	7.88
ZnO/PEIE	75.30	57.62	10.61	9.09
PEIE	72.93	35.40	10.30	5.60
AZO/PEIE	74.15	50.09	9.77	7.29
AZO	73.95	48.56	10.83	7.43

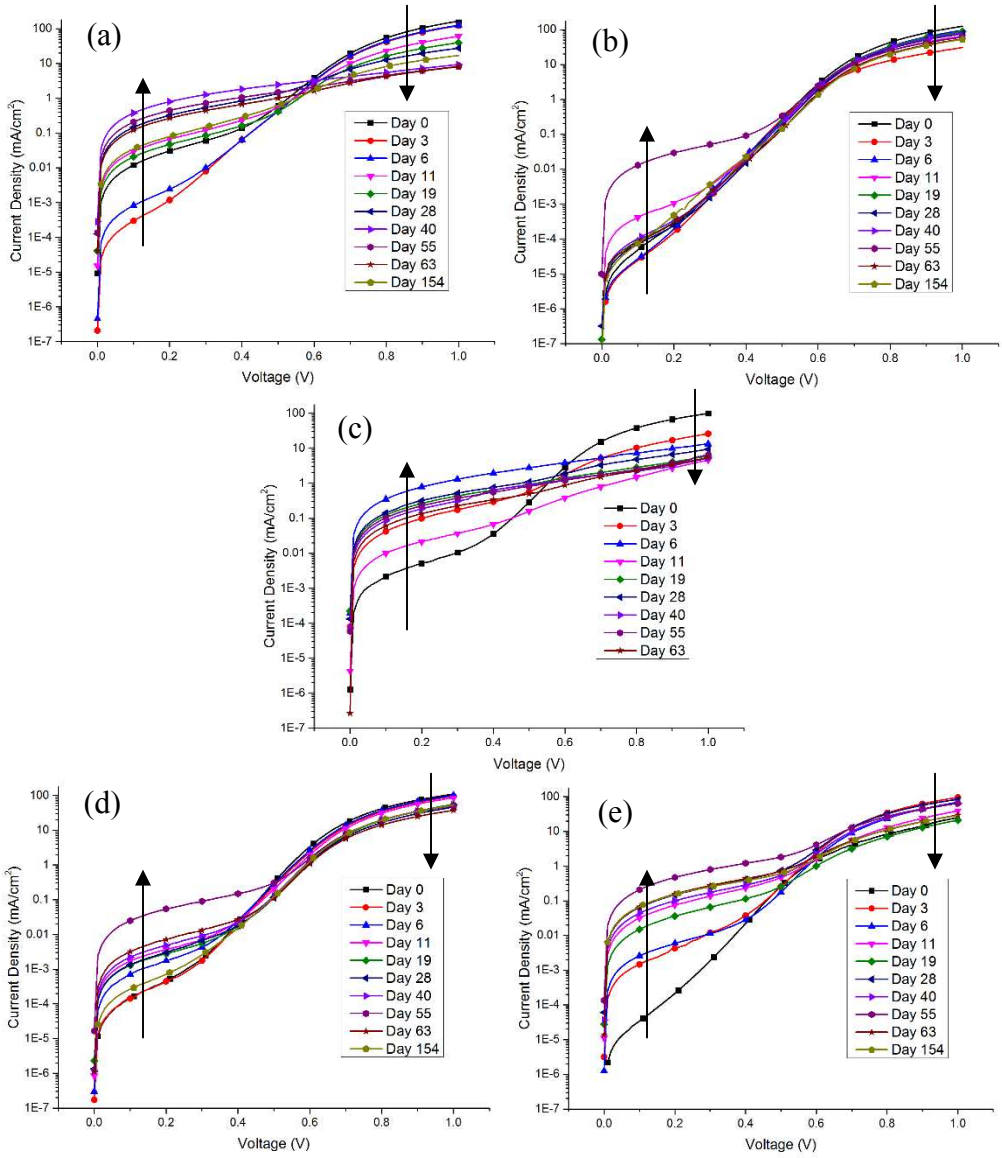

Figure S3 Individual device dark current-voltage curves for up to 154 days of degradation in atmospheric conditions for (a) ZnO, (b) ZnO/PEIE, (c) PEIE, (d) AZO/PEIE, and (e) AZO devices.

Figure S3 shows the dark current-voltage data for each individual device. It can be seen that for each device, the low bias side (~0V) increases with degradation, and the high bias (~1V) decreases with degradation. This calculates directly into the series and shunt resistances for each device, where the low bias shunt resistance decreases over time as more leakage current occurs, and the high bias series resistance increases over time as free charges cease to move freely due to increased amounts of trapped states. Individually, it can be seen that PEIE has the lowest lifetime, as the curve quickly appears to have more resistor features and less diode features as compared to the other devices. For the ZnO and AZO devices, the dark current-voltage curves appear to also have significantly less diode characteristics as compared to their PEIE-coated counterparts. It can be seen for both ZnO/PEIE and AZO/PEIE devices, each show diode characteristics even after 154 days of aging, which shows lower leakage current and less series resistances as compared to devices without the modification.

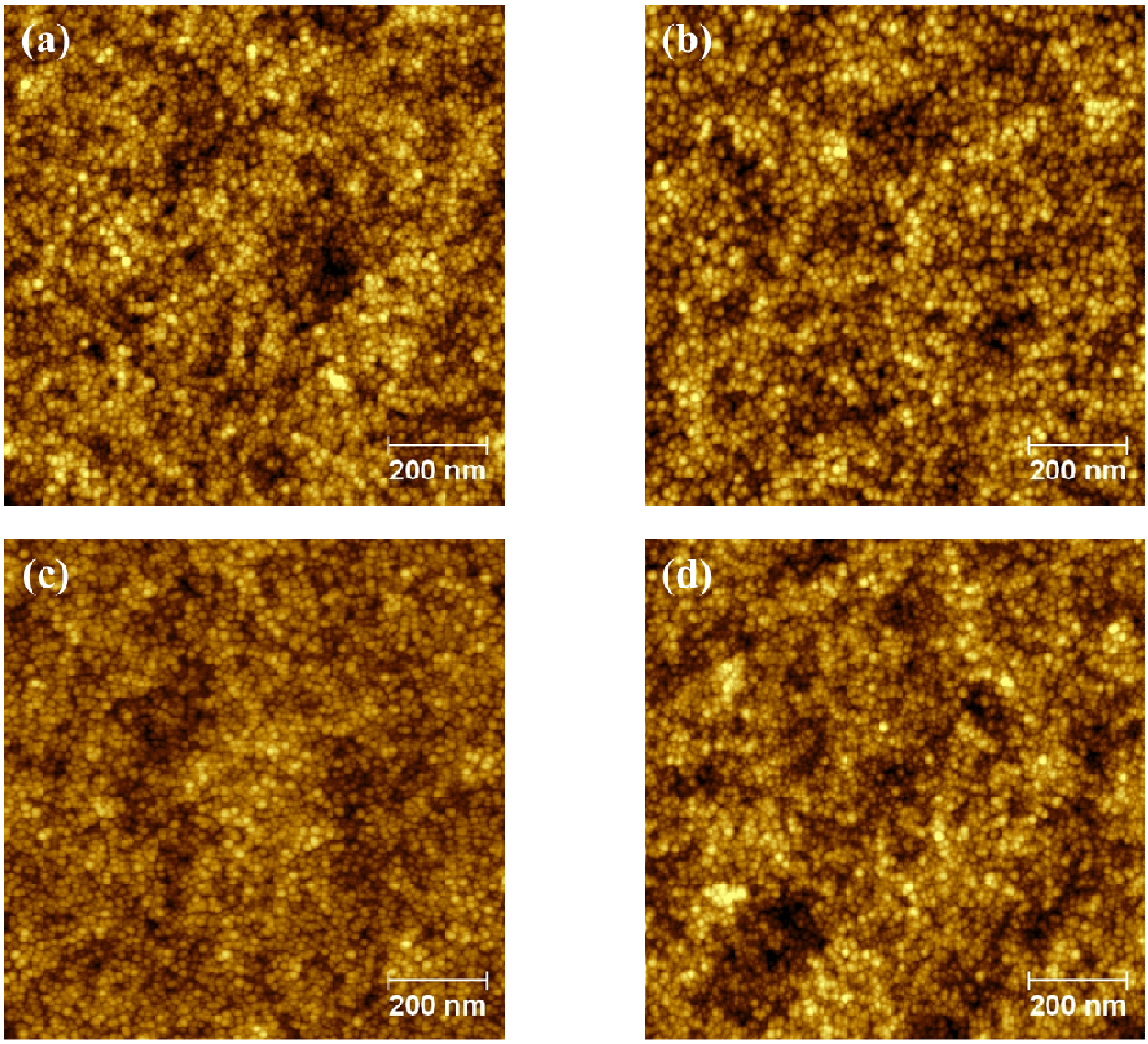

Figure S4 AFM Topography images of (a) Fresh ZnO (b) Aged ZnO (c) Fresh ZnO/PEIE and (d) Aged ZnO/PEIE surface

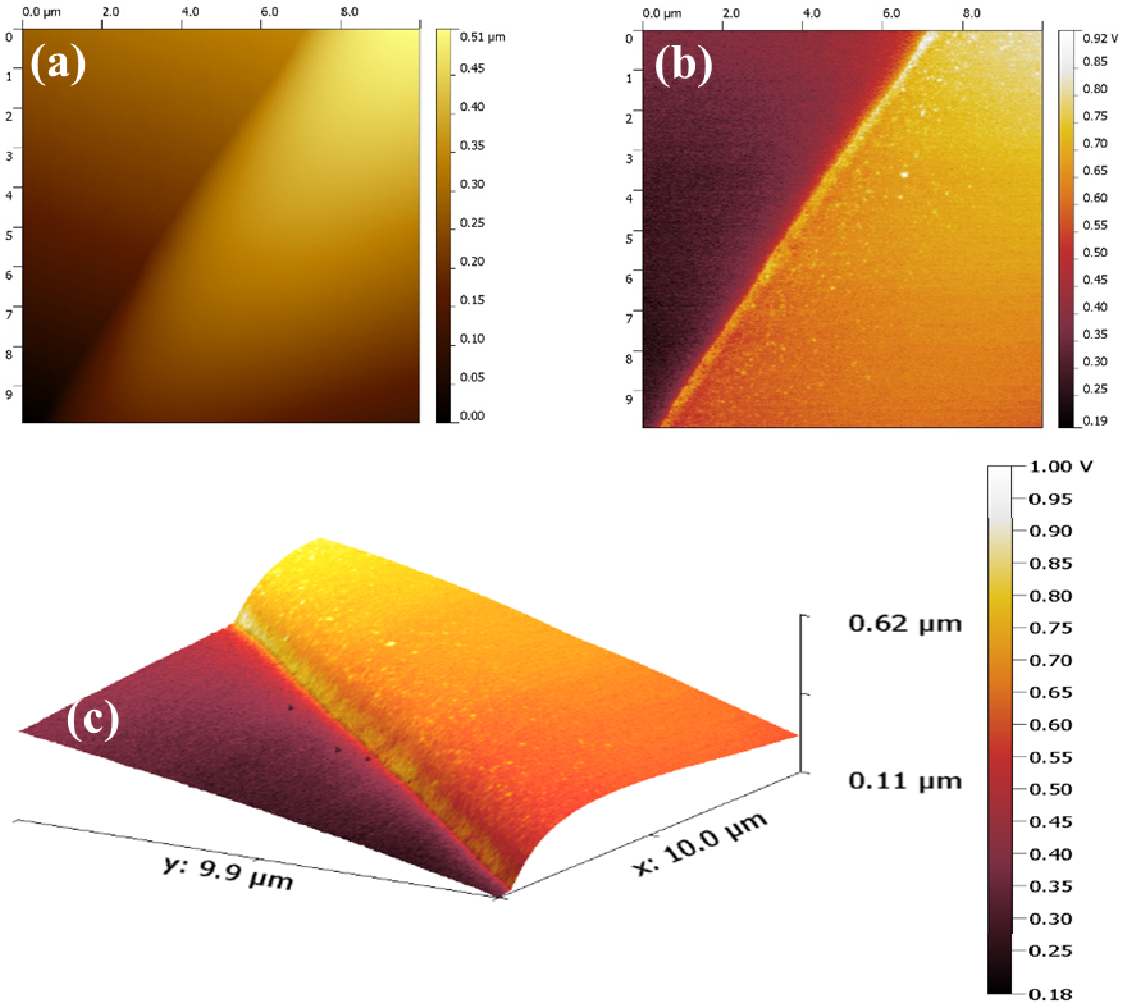

Figure S5 (a) Topography image of ZnO (top left) and PEIE (bottom right) interface, (b) Surface potential image of ZnO/PEIE interface (c) topography image overlaid with surface potential values