

## **Interfacial degradation of the polymer:fullerene bis-adduct solar cells and methods for the stability improvement**

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## Support Information

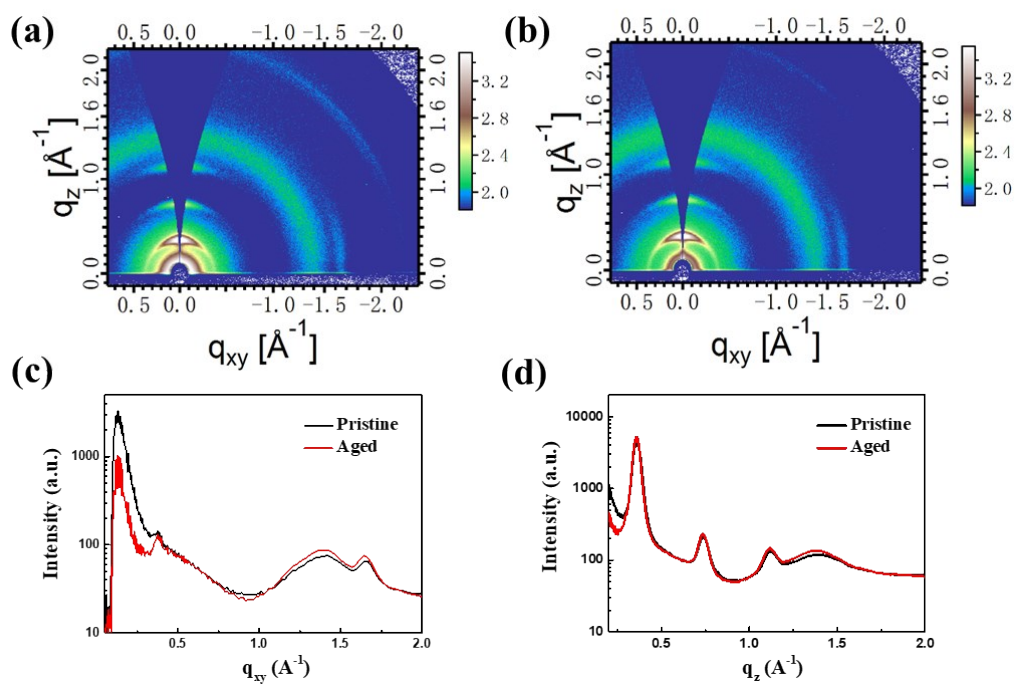


Figure S1 2D GIWAXS patterns of pristine (a) and aged (b) P3HT:bis-PC<sub>61</sub>BM blend films. In-plane (c) and out-of-plane (d) profiles of these films.

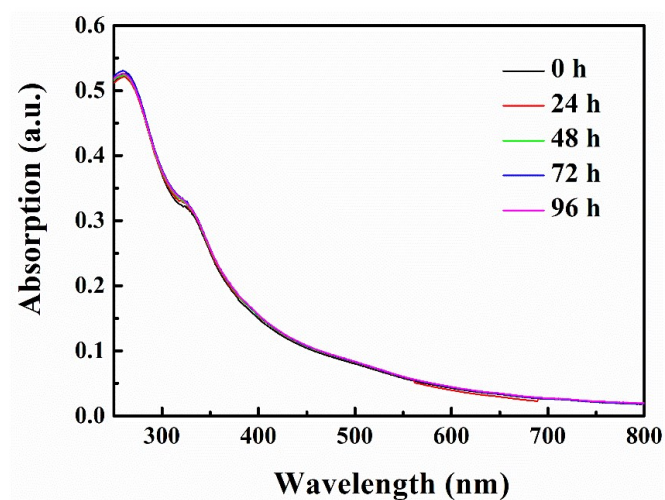


Figure S2 UV-Vis spectra of bis-PC<sub>61</sub>BM film exposed to continuous illumination for different time

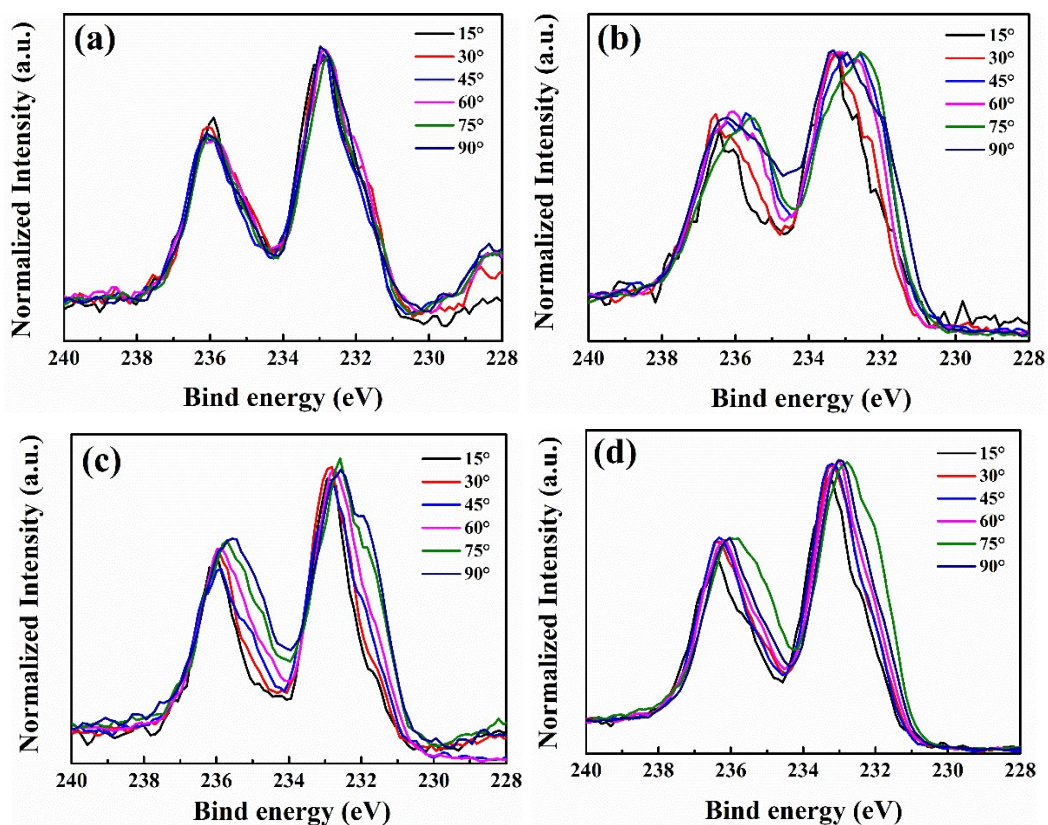


Figure S3 ARXPS spectra of the Mo 3d core level peaks for the pristine P3HT:bis-PC<sub>61</sub>BM/MoO<sub>3</sub> films (a), aged P3HT:bis-PC<sub>61</sub>BM/MoO<sub>3</sub> films (b), aged P3HT:bis-PC<sub>61</sub>BM/C<sub>60</sub>/MoO<sub>3</sub> films (c) and aged P3HT:bis-PC<sub>61</sub>BM:piperazine/MoO<sub>3</sub> films (d).

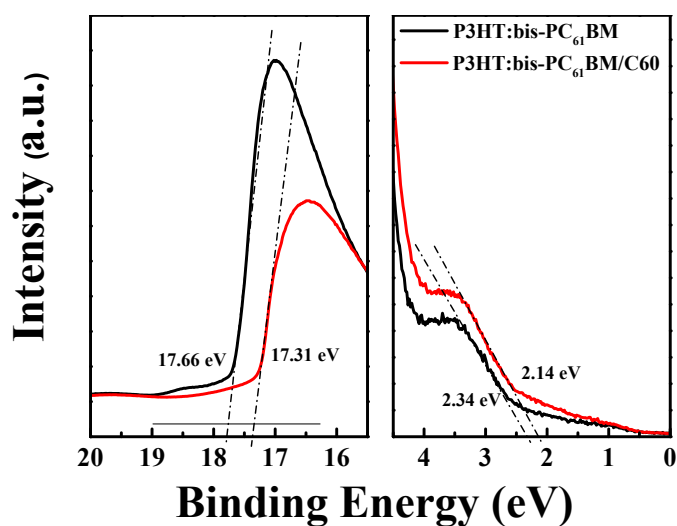


Figure S4 UPS spectra of P3HT:bis-PC<sub>61</sub>BM film (a) and P3HT:bis-PC<sub>61</sub>BM/C<sub>60</sub> film (b).

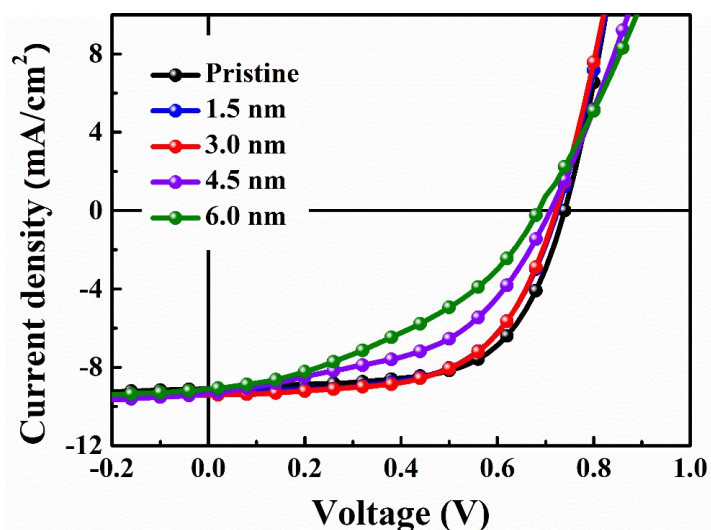
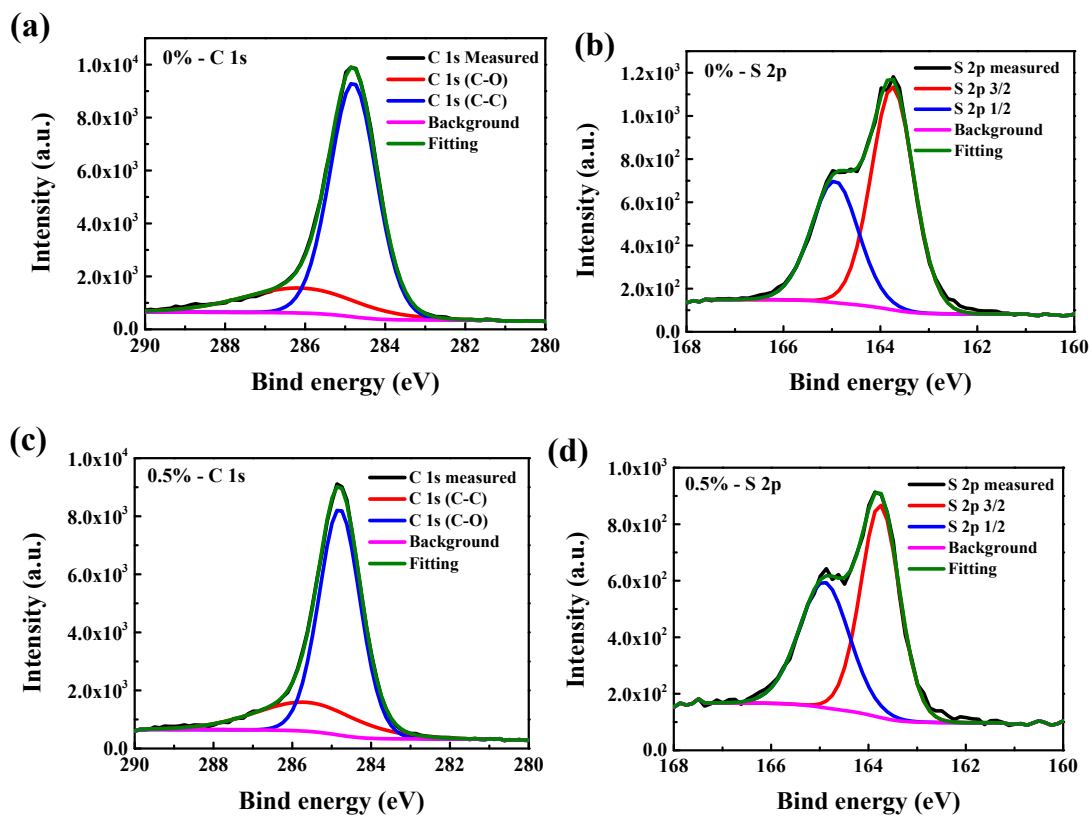


Figure S5  $J$ - $V$  curves of ITO/ZnO/P3HT:bis-PC<sub>61</sub>BM/C<sub>60</sub>/MoO<sub>3</sub>/Al solar cells with different thickness of C<sub>60</sub> layer



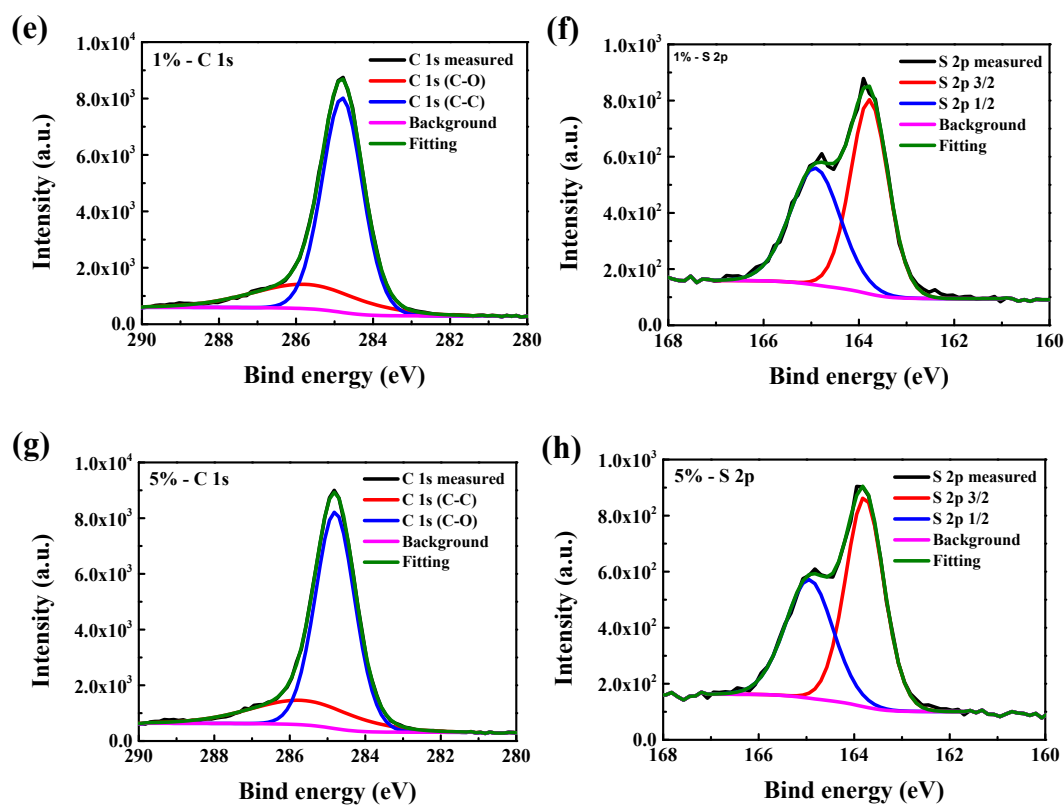


Figure S6 High-resolution deconvoluted XPS spectra of (a, c, e, g) C 1s and (b, d, f, h) S 2p of P3HT:bis-PC<sub>61</sub>BM blend films with different concentration (0-5%) of piperazine

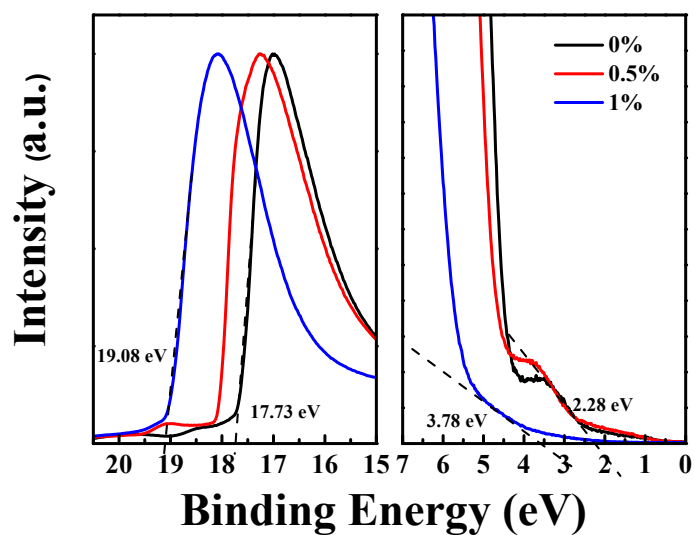


Figure S7 UPS spectra of P3HT:bis-PC<sub>61</sub>BM blend films with different concentration (0-5%) of piperazine

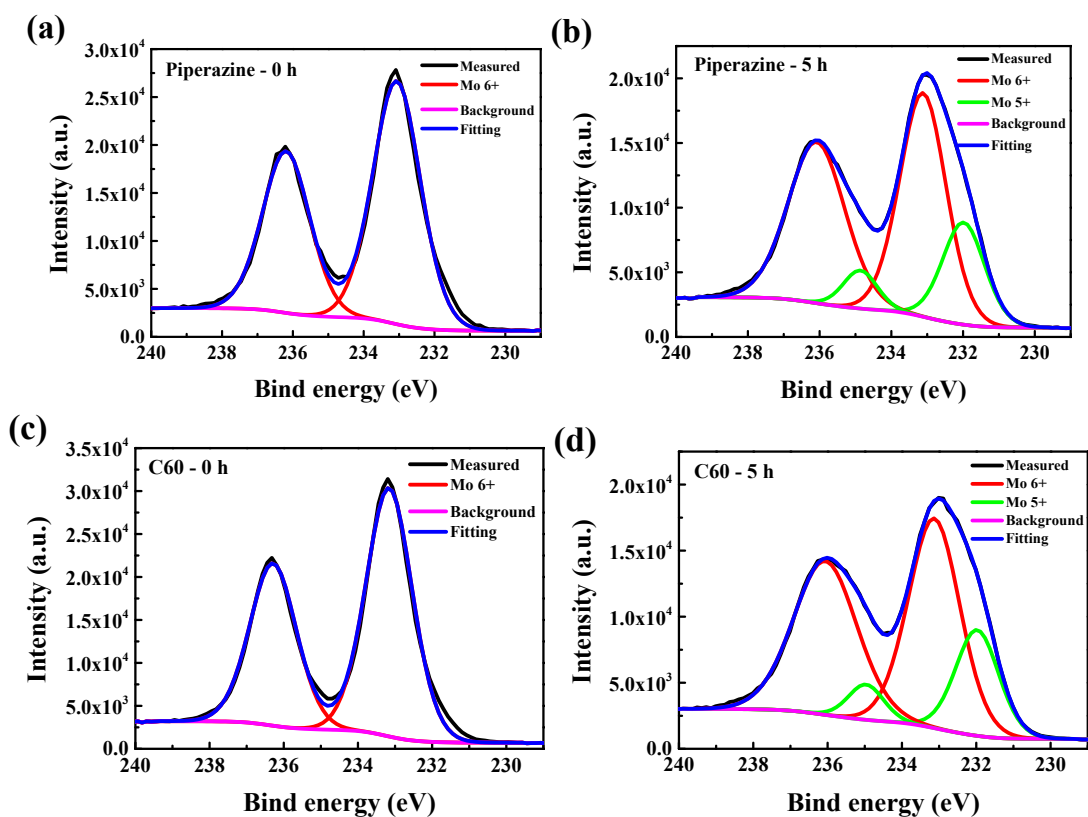


Figure S8 XPS spectra of the Mo 3d core level peaks for the P3HT:bis-PC<sub>61</sub>BM:piperazine/MoO<sub>3</sub> films (a, b) and P3HT:bis-PC<sub>61</sub>BM/C60/MoO<sub>3</sub> films (c, d) before and after illumination for 5 h.

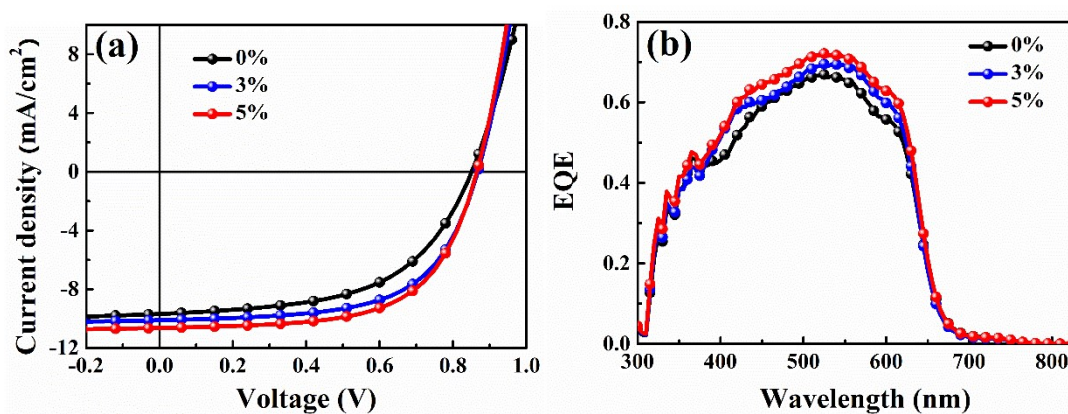


Figure S9  $J$ - $V$  curves (a) and EQE spectra (b) of P3HT:ICBA cells with piperazine doping concentration of 0-5%

Table S1 Photovoltaic parameters of ITO/ZnO/P3HT:bis-PC<sub>61</sub>BM/C60/MoO<sub>3</sub>/Al solar cells with different thickness of C<sub>60</sub> layer

<b>C<sub>60</sub> film thickness (nm)</b>	<b><i>J</i><sub>sc</sub> (mA·cm<sup>2</sup>)</b>	<b><i>V</i><sub>oc</sub> (V)</b>	<b>FF</b>	<b>PCE (%)</b>
0	9.22 (9.15±0.13)	0.73 (0.73±0.005)	0.62 (0.61±0.016)	4.17 (4.08±0.15)
1.5	9.36 (9.31±0.13)	0.72 (0.71±0.008)	0.60 (0.59±0.008)	4.06 (3.92±0.13)
3	9.40 (9.34±0.14)	0.72 (0.71±0.006)	0.60 (0.59±0.006)	4.07 (3.91±0.14)
4.5	9.34 (9.21±0.14)	0.71 (0.71±0.007)	0.49 (0.48±0.006)	3.27 (3.20±0.10)
6	9.12 (9.08±0.16)	0.69 (0.69±0.001)	0.41 (0.39±0.009)	2.54 (2.46±0.12)

Table S2 Photovoltaic parameters of P3HT:ICBA cells with piperazine doping concentration of 0-5%

<b>Piperazine doping concentration</b>	<b><i>J</i><sub>sc</sub> (mA·cm<sup>2</sup>)</b>	<b><i>V</i><sub>oc</sub> (V)</b>	<b>FF</b>	<b>PCE (%)</b>
0	9.69 (9.61 ± 0.15)	0.848 (0.844 ± 0.003)	0.55 (0.55 ± 0.003)	4.52 (4.44 ± 0.09)
3%	10.11 (10.09 ± 0.16)	0.869 (0.866 ± 0.004)	0.61 (0.60 ± 0.02)	5.36 (5.24 ± 0.16)
5%	10.64 (10.59 ± 0.07)	0.867 (0.865 ± 0.002)	0.62 (0.60 ± 0.02)	5.72 (5.50 ± 0.16)