Supporting Information for

**Polyethylenimine as a dual functional additive for electron transporting layer in efficient solution processed planar heterojunction perovskite solar cells**

Sujuan Dong¹, ², Yangyang Wan¹, ², Yaling Wang¹, ², Yin Yang¹, ², Yahui Wang¹, ², Xinyu Zhang,¹, ² Huanqi Cao¹, ², Wenjing Qin¹, ², Liying Yang¹, ², Cong Yao ³*, Ziyi Ge ⁴*, Shougen Yin¹, ²*

¹ Key Laboratory of Display Materials and Photoelectric Devices, Education Ministry of China, School of Materials Science and Engineering, Tianjin University of Technology, Tianjin 300384, China
² Tianjin Key Laboratory for Photoelectric Materials and Devices, Tianjin University of Technology, Tianjin 300384, China
³ China Electronics Technology Group Corporation No.18th Research Institute, Tianjin 300384, China
⁴ Ningbo Institute of Materials Technology & Engineering, Chinese Academy of Sciences, Ningbo 315201, China

Email: liyingyang@tjut.edu.cn; sgyin@tjut.edu.cn; geziyi@nimte.ac.cn and huobingyao@vip.qq.com

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Polyethylenimine; Trap states
Fig.S1 J-V curves for the planar perovskite solar cells (ITO/PEDOT: PSS/perovskite /PCBM or PCBM+PEI/Al) with different PEI doping concentration and without doping.
Fig. S2 J-V characteristics for the best device with a structure of

ITO/PEDOT: PSS/perovskite/PCBM/PEI/Al

<table>
<thead>
<tr>
<th>Device cathode configuration</th>
<th>Voc (V)</th>
<th>Jsc (mA/cm²)</th>
<th>FF (%)</th>
<th>PCE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCB/Al</td>
<td>0.81</td>
<td>14.51</td>
<td>52.3</td>
<td>6.1</td>
</tr>
<tr>
<td>PCB/PEI/Al</td>
<td>0.84</td>
<td>14.96</td>
<td>55.7</td>
<td>7.0</td>
</tr>
</tbody>
</table>

Table S1 The photovoltaic parameter of the best devices for ITO/PEDOT: PSS/perovskite/PCBM/Al and ITO/PEDOT: PSS/perovskite/PCBM/PEI/Al
Fig. S3 Transfer characteristics of $I_{DS}^{1/2}$ - $V_{GS}$ for OFETs with PCBM and PCBM blended with different contents of PEI as channel materials.
Fig. S4 SEM images (a) and AFM topography (b) of the pristine perovskite layer
Fig. S5 The AFM topography and phase images of the PCBM films (without or with 1~5 wt % PEI) coated on perovskite layer.
Fig. S6 The AFM topography and phase images of the PEI film coated on PCBM/perovskite layer.

Fig. S7 UV-vis absorption spectra of the PCBM films (without or with 1~5 wt % PEI) coated on perovskite layer
Fig. S8 Steady-state PL spectra of the films perovskite, perovskite/PCBM, perovskite/PCBM+1~5 wt % PEI