Supplementary Information

Room-Temperature, Solution-Processable Organic Electron Extraction Layer for High-Performance Planar Heterojunction Perovskite Solar Cells

Jong H. Kim\textsuperscript{a,b,c} Chu-Chen Chueh\textsuperscript{c} Spencer T. Williams\textsuperscript{c} and Alex K.–Y. Jen\textsuperscript{*c,d}

\textsuperscript{a}. Department of Chemical Engineering Education, Chungnam National University, 99 Daehak-ro, Yuseong-gu, 305-764, South Korea.
\textsuperscript{b}. Graduate School of Energy Science and Technology, Chungnam Naional University, 99 Daeak-ro, Yuseong-gu, 305-764, South Korea.
\textsuperscript{c}. Department of Materials Science and Engineering, University of Washington, Seattle, WA, 98195-2120, USA.
\textsuperscript{d}. Department of Chemistry, University of Washington, Seattle, WA, 98195-1700, USA.

*Address correspondence to: ajen@u.washington.edu

\textbf{Figure S1.} Atomic force microscopy images of FPI-PEIE and PC\textsubscript{61}BM on FPI-PEIE (scale bar: 1\,\mu\text{m}).
Figure S2. (a) Transfer characteristics of field-effect transistors based on pristine PC$_{61}$BM (circles), pristine CH$_3$NH$_3$Pbl$_3$ (squares) and PC$_{61}$BM/CH$_3$NH$_3$Pbl$_3$ (diamonds), and (b) output characteristics of field-effect transistors based on pristine PC$_{61}$BM (circles), pristine CH$_3$NH$_3$Pbl$_3$ (squares) and PC$_{61}$BM/CH$_3$NH$_3$Pbl$_3$ (diamonds) at zero gate voltage.

Figure S3. $J$–$V$ characteristics of the studied CH$_3$NH$_3$Pbl$_3$ solar cell based on FPI-PEIE/PC$_{61}$BM layer under AM 1.5G irradiation at 100 mW cm$^{-2}$. The scan rate is 0.05 V s$^{-1}$. 
Figure S4. $J$–$V$ characteristics of the control perovskite solar cell using a single PC$_{61}$BM layer as the EEL under AM 1.5G irradiation at 100 mW cm$^{-2}$. 