Electronic Supplementary Information

A dimeric fullerene derivative for efficient inverted planar perovskite solar cells with improved stability

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General Methodology

All chemicals were reagent grade, purchased from Sigma Aldrich. Silica gel (Redisep silica, 40-60 μ, 60 Å) was used to separate the products from the pristine fullerene. MALDI-TOF mass spectrometric measurements were obtained on a Bruker Microflex LRF mass spectrometer on reflector positive mode. The NMR spectra were recorded using a Bruker 400 MHz spectrometer. The UV/Vis-NIR spectra were taken using a Cary 5000 UV/Vis-NIR spectrophotometer using toluene solutions. Cyclic voltammetry (CV) experiments were carried out under an Argon atmosphere at room temperature using a CH Instrument Potentiostat. Scan rate for CV experiments was 100 mV/s. A one compartment cell with a standard three-electrode set up was used, consisting of a 1 mm diameter glassy carbon disk as the working electrode, a platinum wire as the counter electrode and a silver wire as the pseudo-reference electrode, in a solution of anhydrous *o*-DCB containing 0.05 M *n*-Bu_4NPF_6. Ferrocene was added to the solution at the end of each experiment as an internal standard.

Characterization of D-C_{60}

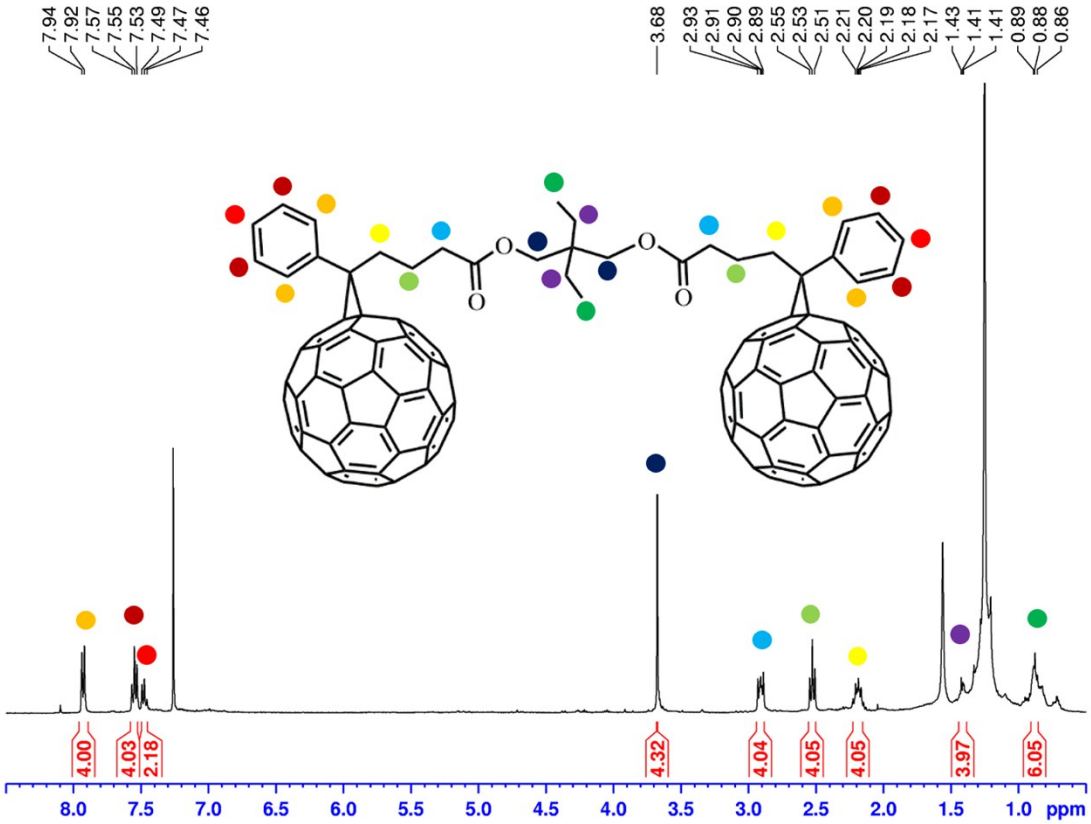

Figure S1. ^{1}H-NMR (400 MHz; $CDCl_3$, 298 K) of D-C_{60}.

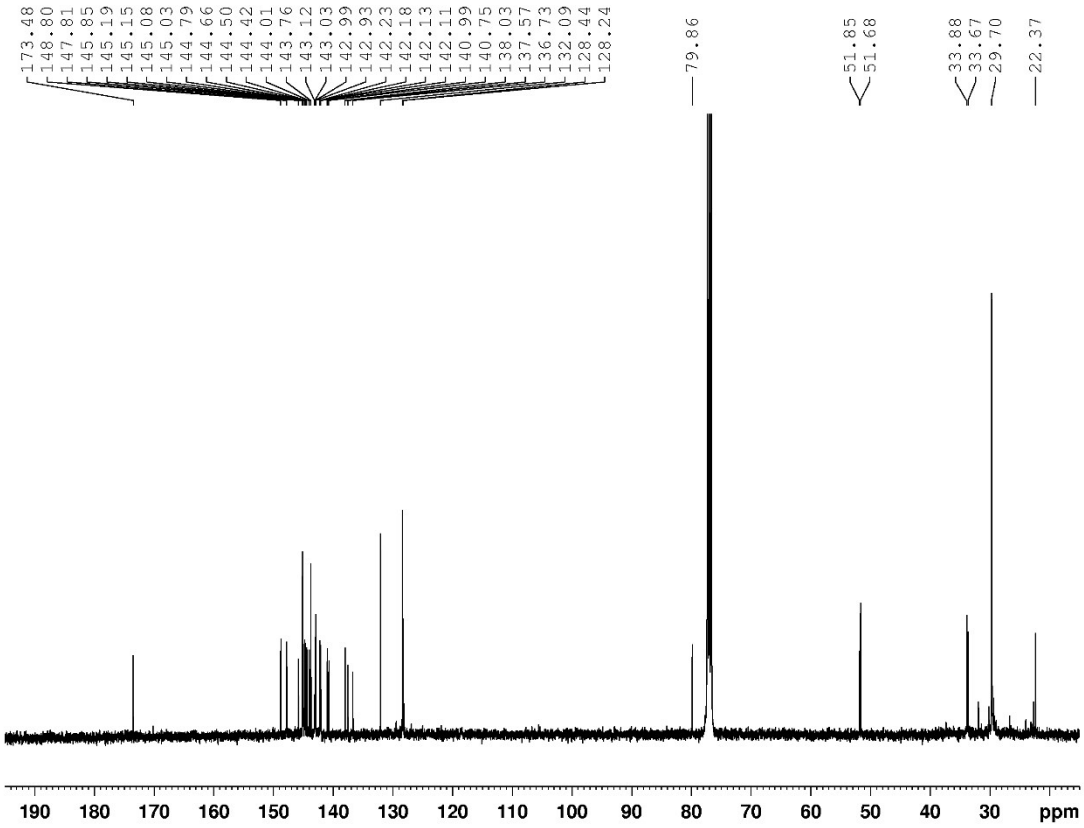

Figure S2. ^{13}C-NMR (100 MHz; $CDCl_3$, 298 K) of D-C_{60}.

Electrochemical Properties.

The electrochemical properties of $PC_{61}BM$ and D-C_{60} were measured by cyclic voltammetry (CV) on a glassy carbon electrode with *o*-dichlorobenzene (*o*-DCB) as solvent and *n*-Bu_4NPF_6 as supporting electrolyte. The reduction potentials are shown in **Table 1**. The reduction potentials of $PC_{61}BM$ and D-C_{60} are similar.

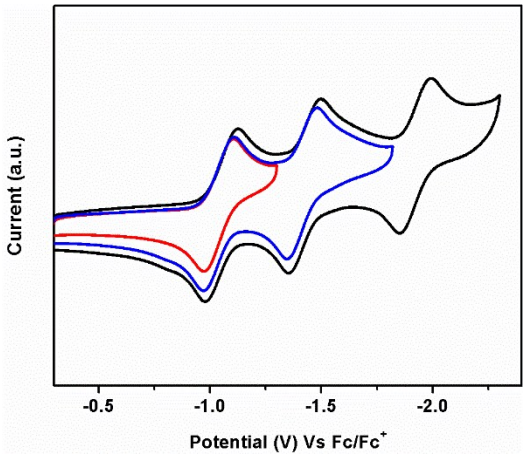

Figure S3. Cyclic voltammetric curves of D-C_{60} at a scan rate of 100 mV/s.

Table S1. Redox Potentials of $PC_{61}BM$ and D-C_{60}.

Compound	$E^{0/-}$	$E^{-/-2}$	$E^{-2/-3}$
$PC_{61}BM$	-1.03	-1.41	-1.90
D-C_{60}	-1.05	-1.44	-1.92

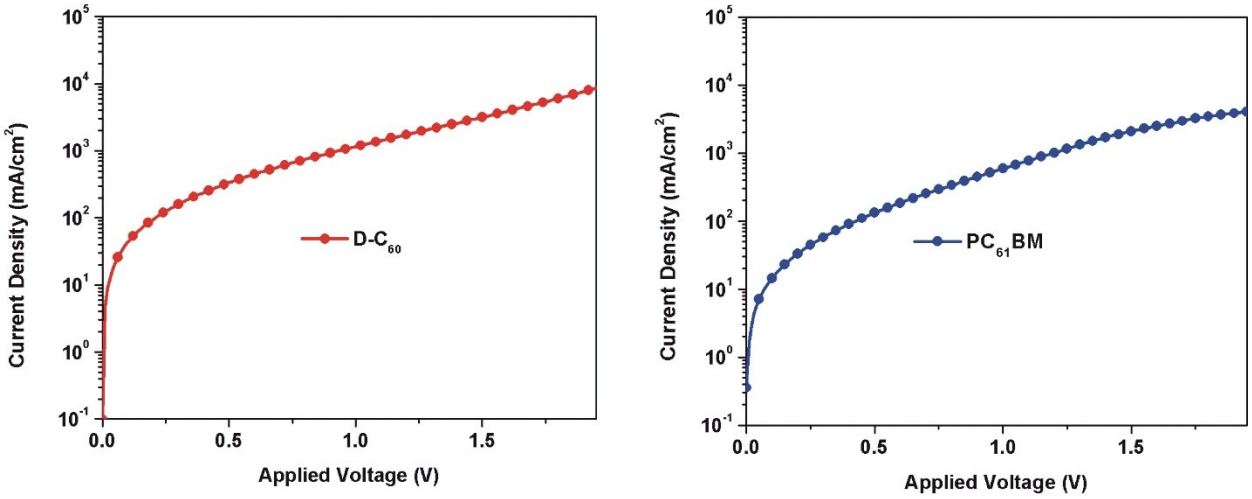

Figure S4. Measured space-charge limited *J–V* characteristics of the $PC_{61}BM$ and D-C_{60} for electron-only devices. The devices with a structure of ITO/Cs_2CO_3/ D-C_{60} ($PC_{61}BM$)/Ca/Al were fabricated.

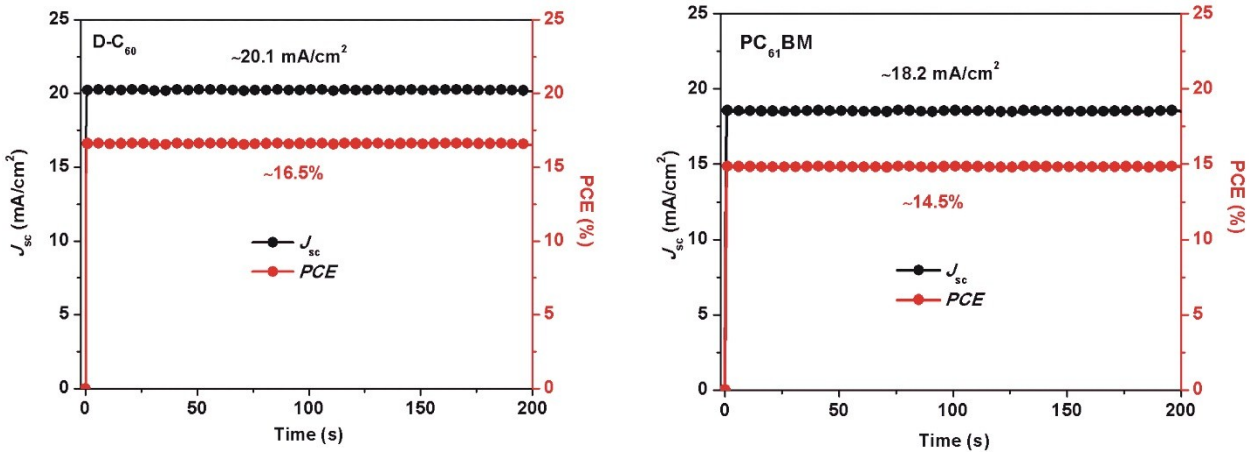

Figure S5. Maximal steady-state photocurrent output at the maximum power point (for $PC_{61}BM$ based device at 0.80 V, and D-C_{60} based device at 0.82 V) and their corresponding power output.

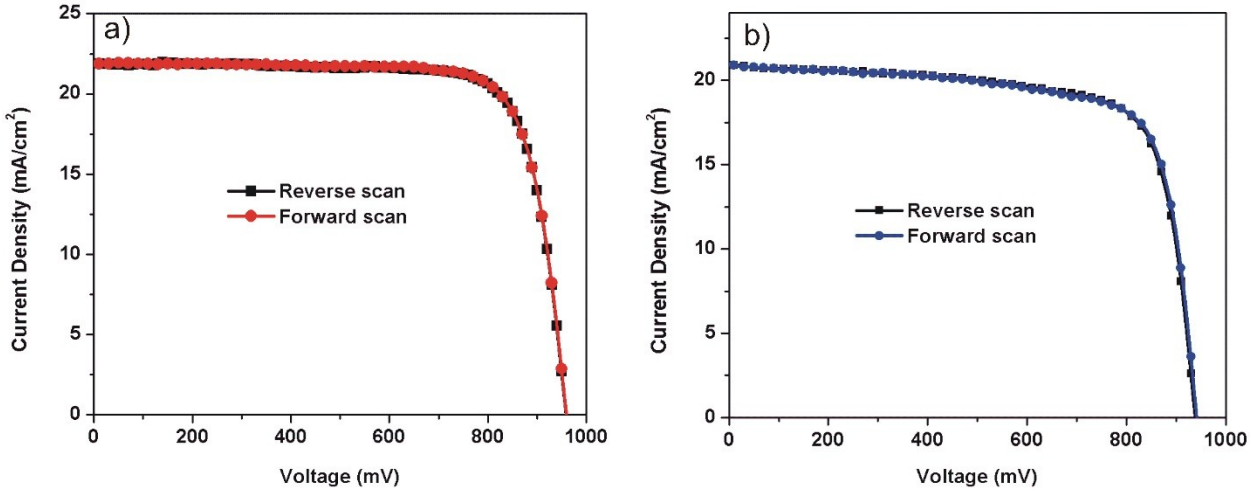

Figure S6. *J-V* curves of the inverted planar perovskite solar cells based on D-C_{60} and $PC_{61}BM$ with respect to forward and reverse scan directions (The scanning rate was 100 mV/s).

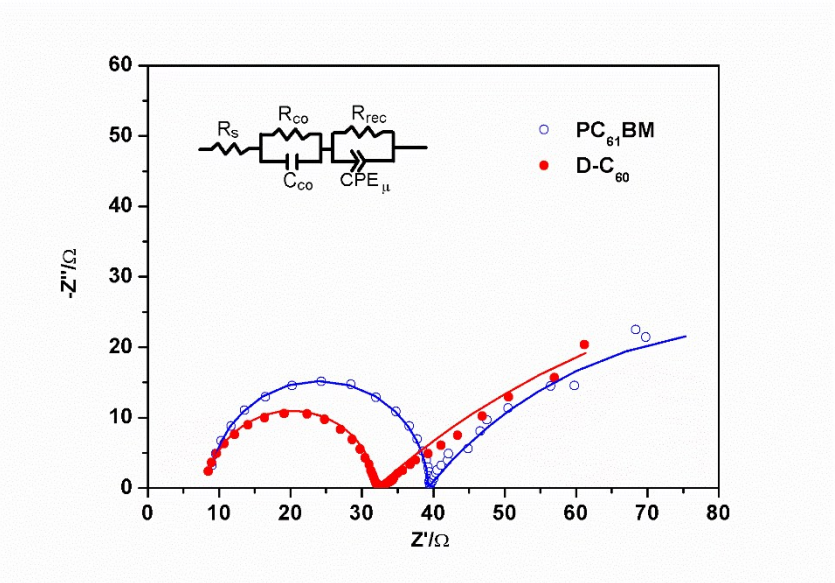

Figure S7. Nyquist plots of the perovskite solar cells based on $PC_{61}BM$ and D-C_{60}.

Table S2. Fitting parameters for EIS data under 1 sun illumination.

Device	Rs(Ω)	Rco(Ω)	Cco(F)	Rrec(Ω)	CPEμ-T(F)	CPEμ-p(F)
$PC_{61}BM$	8.80	30.43	1.959E-8	92.85	0.02028	0.5734
D-C_{60}	8.26	23.68	5.353E-8	146.7	0.02879	0.9543