Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting information

Fullerene imposed high open-circuit voltage in efficient perovskite based solar cells

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Content:

Perovskite thin film characterization.

Absorption spectra and optical and atomic force microscope images of the different fullerene films.

Forward and reverse current density versus voltage scans under 1 sun illumination of all device configuration studied.

Information about spreading in device results.

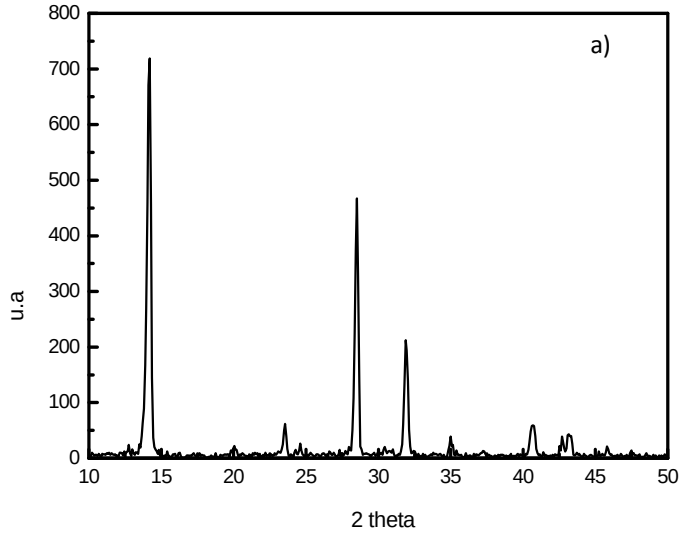


Fig. S1. GIXRD for the vacuum deposited film (320nm) of $CH_3NH_3PbI_3$ with a preferred orientation along the (100) and (001) directions

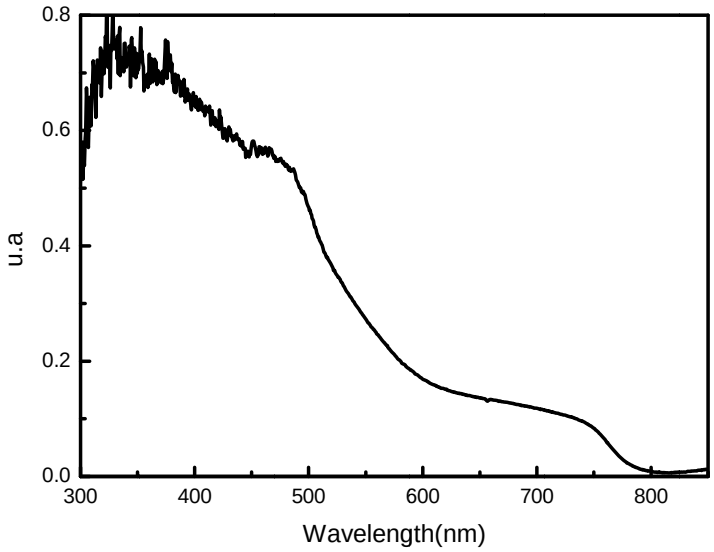


Fig. S2. Optical absorption spectrum of the vacuum deposited film (320nm) of $CH_3NH_3PbI_3$

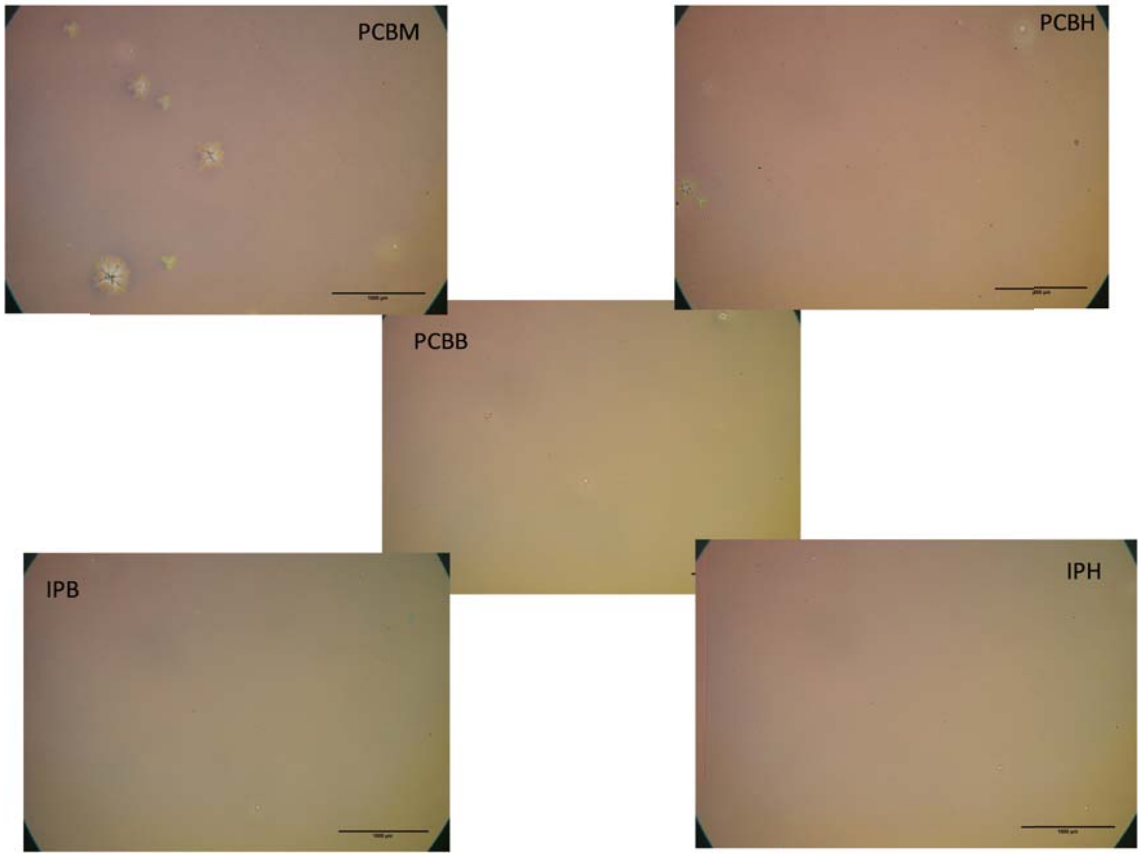
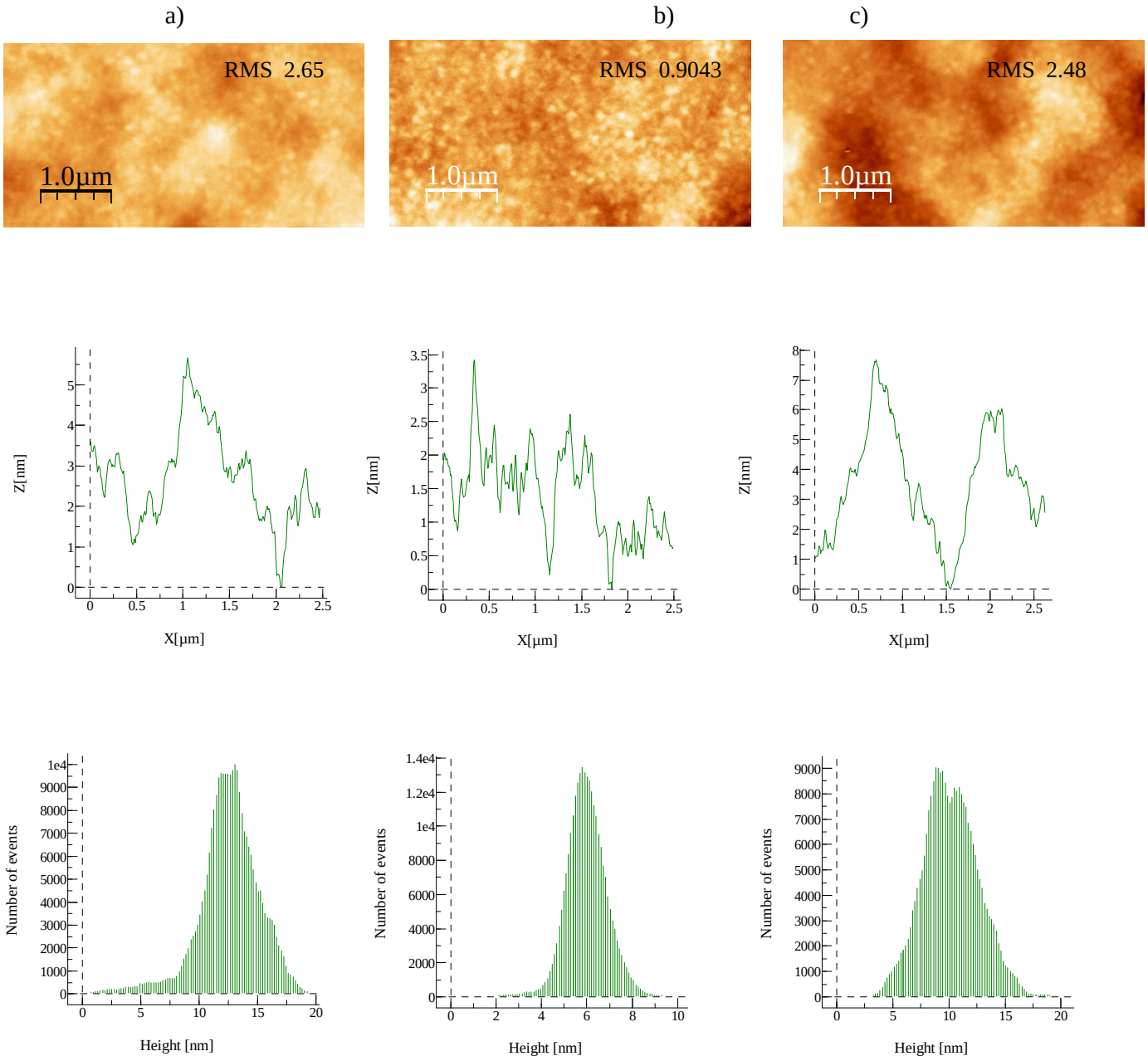


Fig S3. Optical microscope images of the fullerene layers on top of the perovskite


a)
b)
c)
RMS 2.65
1.0µm
RMS 0.9043
1.0µm
RMS 2.48
1.0µm
Z[nm]
X[µm]
Number of events
Height [nm]

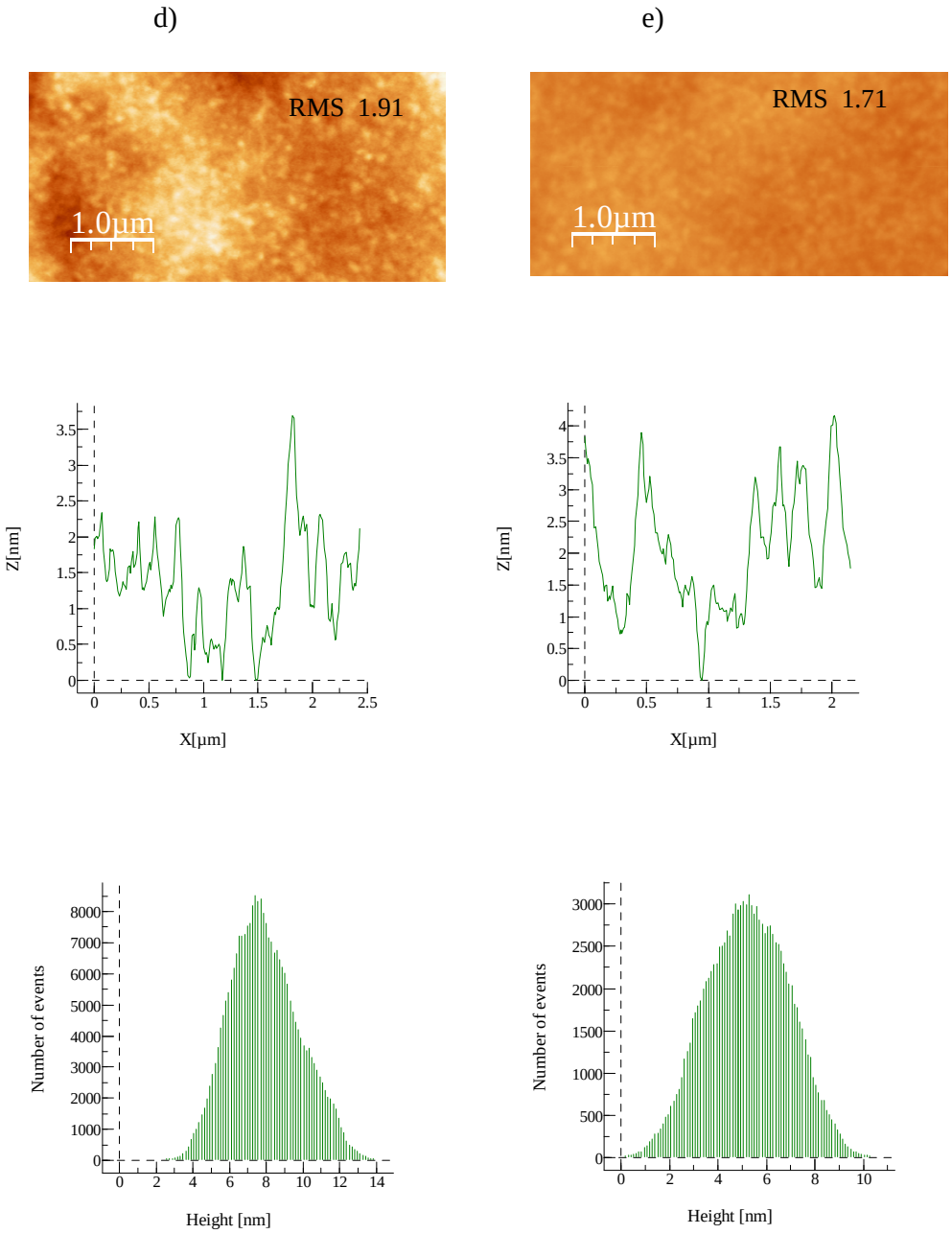


Fig S4. Atomic Force microscopy (AFM) characterization of a) PCBM b) PCBB c) PCBH d) IPB e) IPH

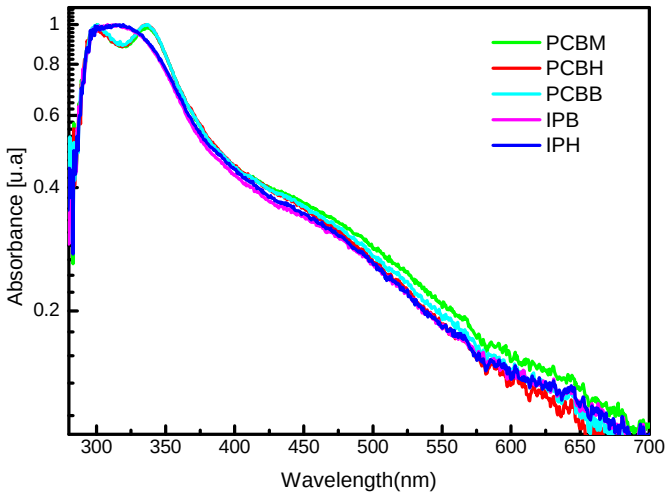
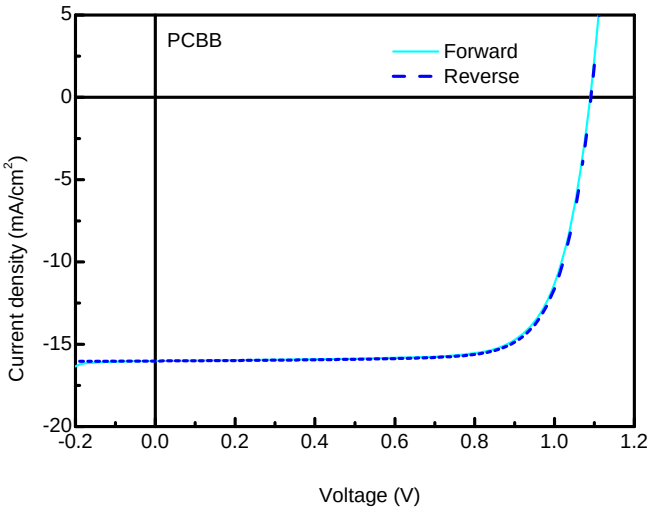
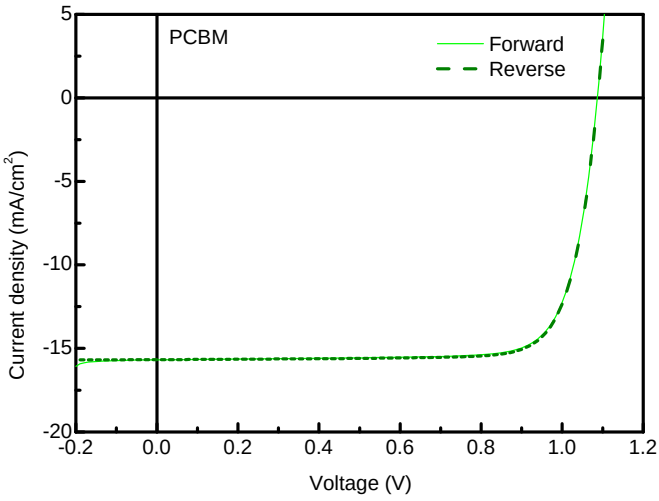
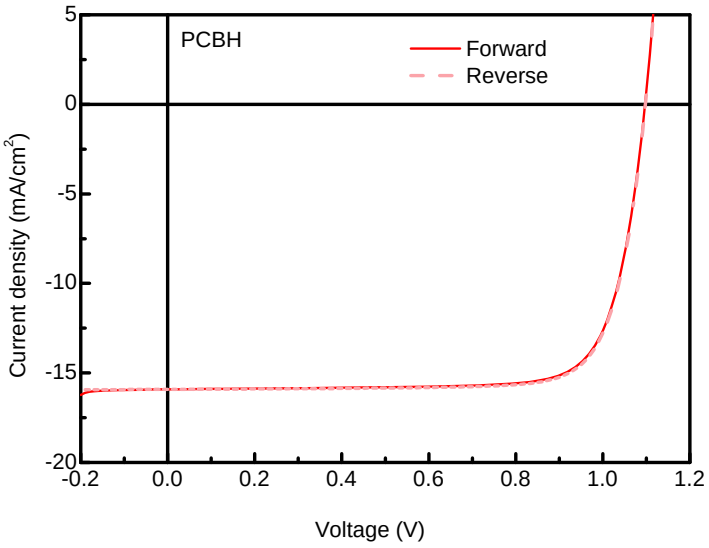
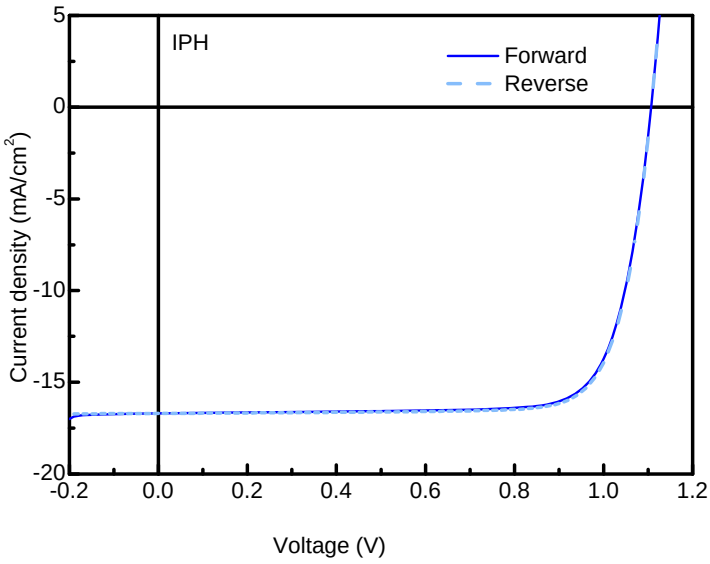


Fig S5. Optical absorption of the different fullerene films on quartz plates up to 600nm.


PCBB
Forward
Reverse
Current density (mA/cm^2)
Voltage (V)
5
0
-5
-10
-15
-20
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2


PCBM
Forward
Reverse
Current density (mA/cm^2)
Voltage (V)
5
0
-5
-10
-15
-20
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2


PCBH
Forward
Reverse
Current density (mA/cm^2)
Voltage (V)
5
0
-5
-10
-15
-20
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2


IPH
Forward
Reverse
Current density (mA/cm^2)
Voltage (V)
5
0
-5
-10
-15
-20
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
1.2

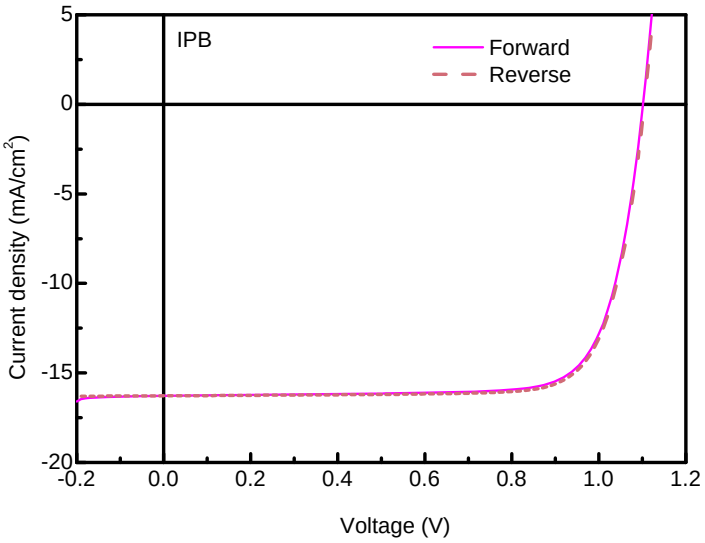
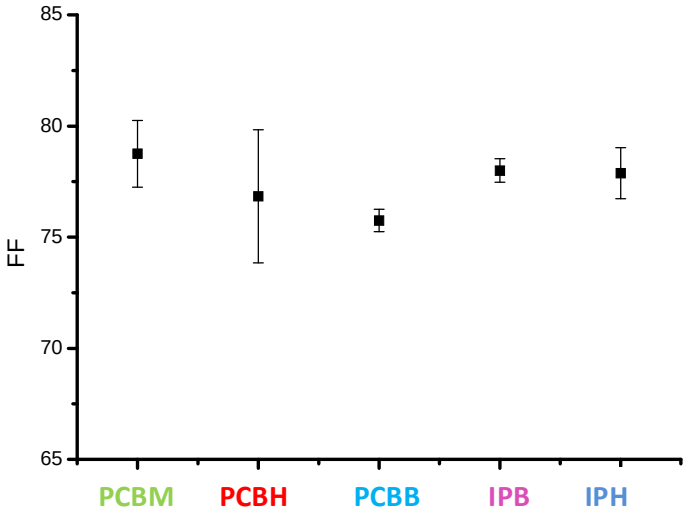
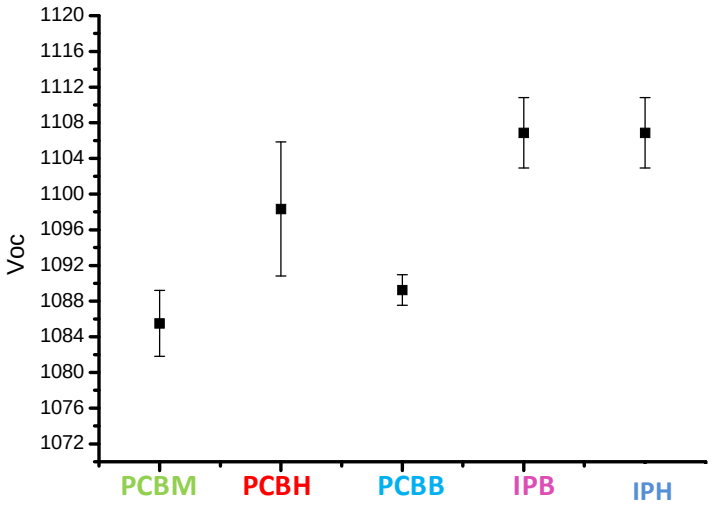


Fig. S6. Forward and reverse current density versus voltage curves for the solar cells using the five different fullerenes. Scan speed was 0.01 V/s.




Voc
1120
1116
1112
1108
1104
1100
1096
1092
1088
1084
1080
1076
1072
PCBM
PCBH
PCBB
IPB
IPH

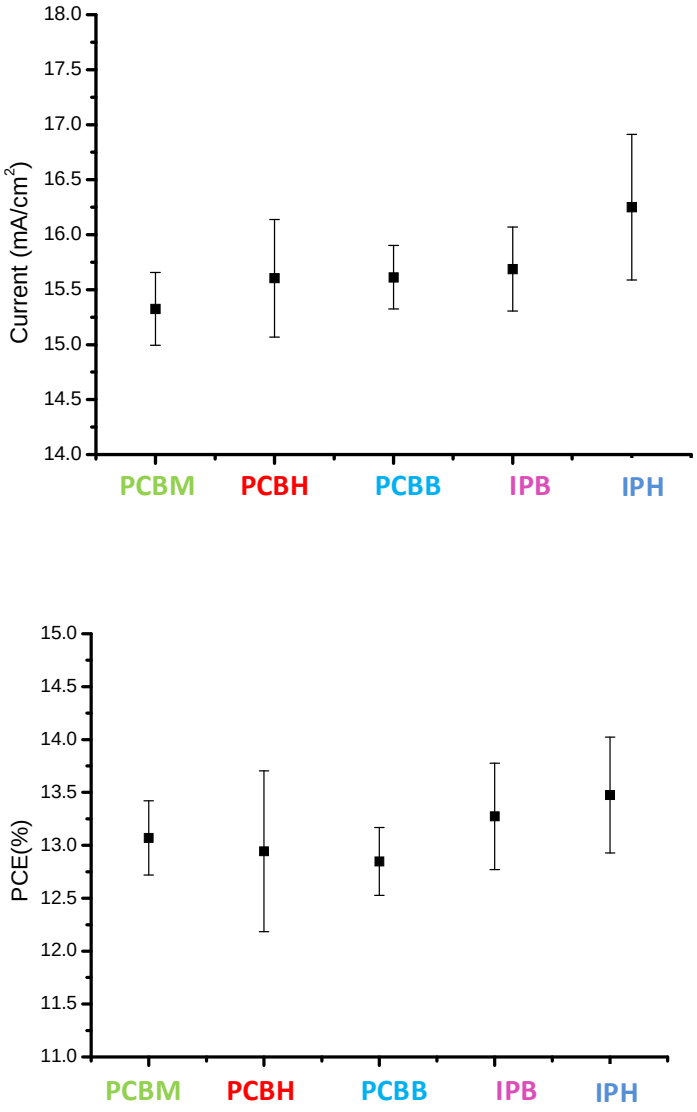


Fig S7. Photovoltaic parameters (Jsc,Voc,FF,PCE) of the different fullerenes for > 8 devices per configuration .