

# Supporting Information

## Aging of quinoxaline-based polymer solar cells under UV-free white light

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## 1. Processing conditions

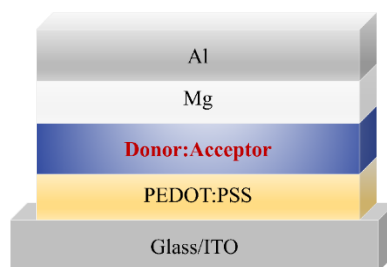
**TTFQ<sub>x</sub>-T1:PC<sub>70</sub>BM:** Solvent additive: 0.5 vol.-% DIO, no thermal annealing.

**TTFQ<sub>x</sub>-T1:ITIC:** Annealed at 150°C for 10 min inside the GB, no solvent additive.

**HFAQ<sub>x</sub>-T:PC<sub>70</sub>BM:** Solvent additive: 0.25 vol.-% DIO, no thermal annealing.

**HFAQ<sub>x</sub>-T:ITIC:** Annealed at 130°C for 10 min inside the GB, no solvent additive.

### Layer stack of the conventional architecture organic solar cell



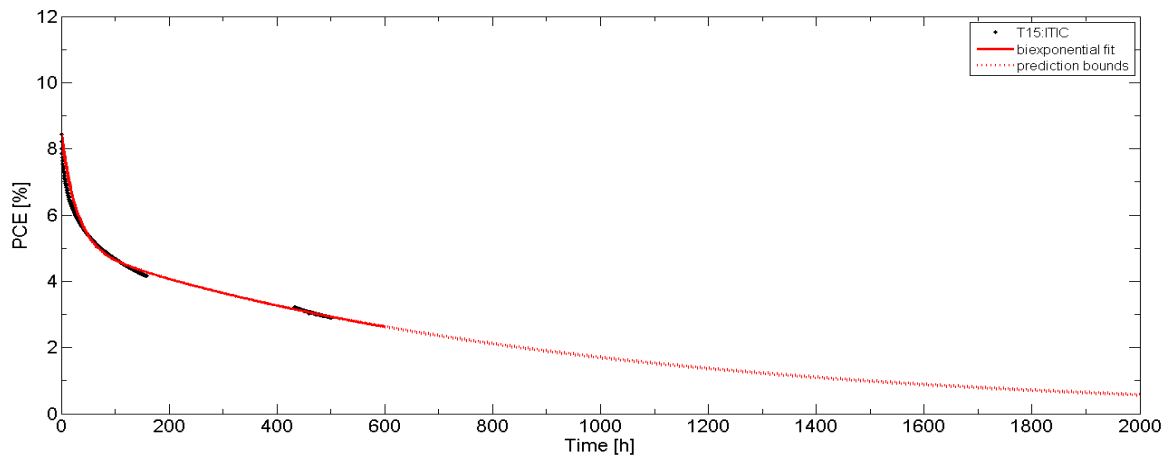
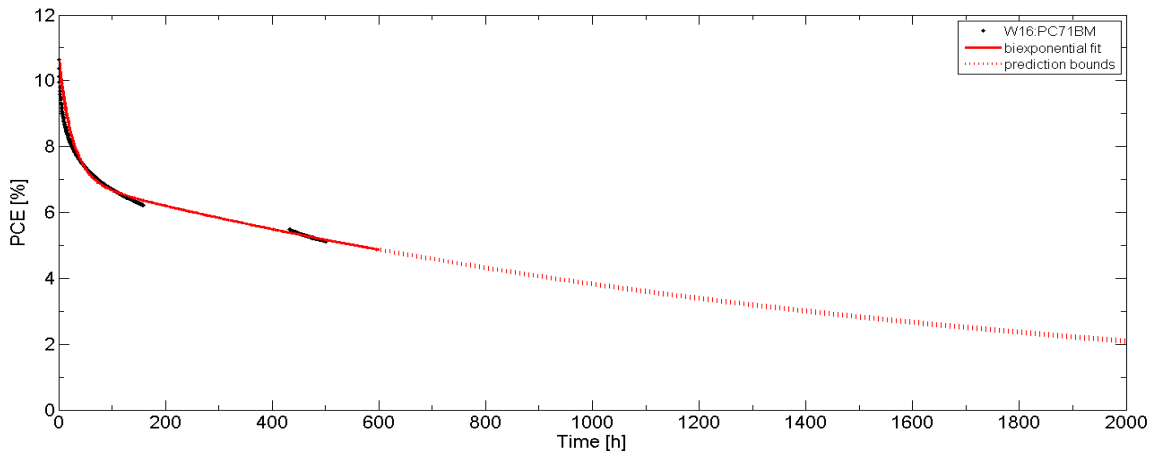
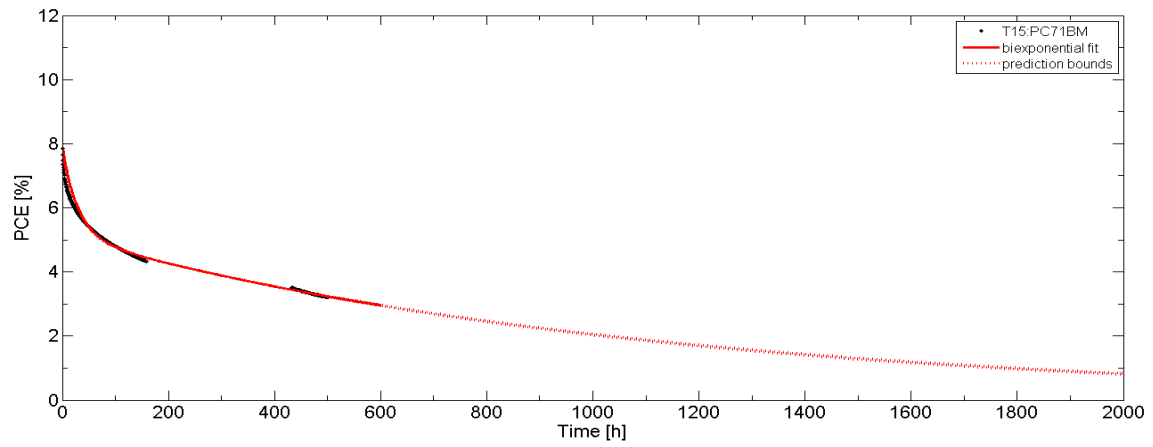
*Figure S1: The layer of fabricated organic solar cells in conventional architecture.*

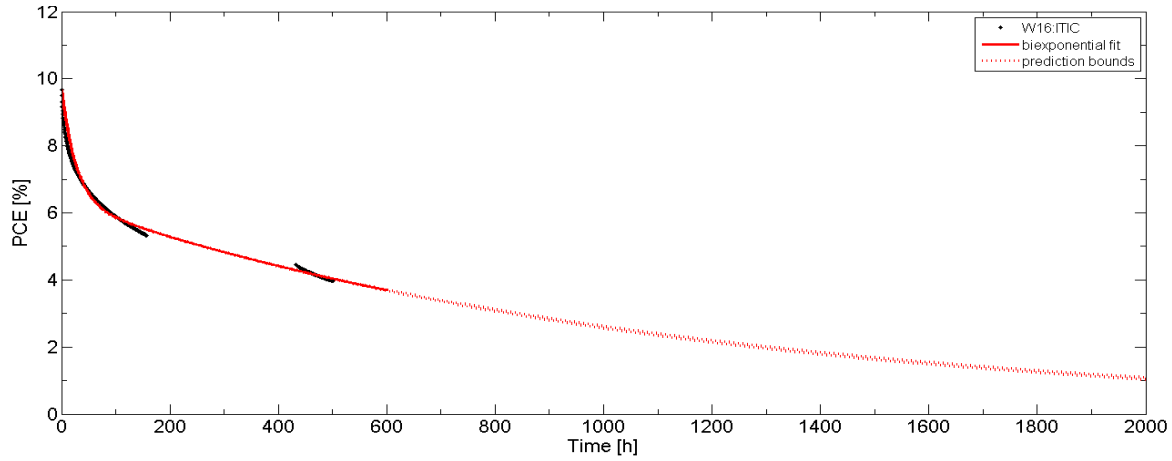
## 2. PV parameters

*Table S1: Solar cell parameters of the TTFQ<sub>x</sub>-T1:PC<sub>70</sub>BM, HFAQ<sub>x</sub>-T:PC<sub>70</sub>BM, TTFQ<sub>x</sub>-T1:ITIC and HFAQ<sub>x</sub>-T:ITIC based solar cells.*

Samples	$J_{sc}$ [mA/cm <sup>2</sup> ]	$V_{oc}$ [mV]	FF [%]	PCE [%]	$R_s$ [Ω]	$R_p$ [Ω]
TTFQ <sub>x</sub> -T1:PC <sub>70</sub> BM	12.48	783	52	5.1	8	699
HFAQ <sub>x</sub> -T:PC <sub>70</sub> BM	13.92	878	58	7.07	9	516
TTFQ <sub>x</sub> -T1:ITIC	12.65	877	57	6.31	19	493
HFAQ <sub>x</sub> -T:ITIC	14.04	870	52	6.36	7	1438

### 3. Aging fit

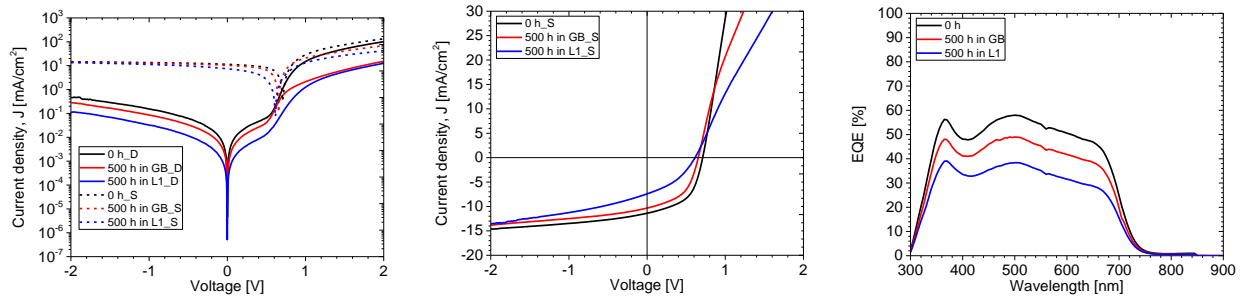




**Figure S2:** Bi-exponential fit of decay curves of TTFQx-T1:PC<sub>70</sub>BM, TTFQx-T1:ITIC, HFAQx-T:PC<sub>70</sub>BM and HFAQx-T:ITIC based solar cells.

## 2. Ageing data

### 2.1 TTFQx-T1:PC<sub>70</sub>BM



**Figure S3:** Dark J-V, sun J-V and EQE measurements of TTFQx-T1:PC<sub>70</sub>BM based solar upon three ageing conditions.

**Table S2:** Solar cell parameters of TTFQx-T1:PC<sub>70</sub>BM based solar upon three ageing conditions.

Sample	Ageing condition	Jsc (mA/cm <sup>2</sup> )	Jsc_EQE (mA/cm <sup>2</sup> )	Voc (mV)	FF (%)	PCE (%)	PCE_EQE (%)	Rs (Ohm)	Rp (Ohm)
SAI5015_3	0 hr	10.72	10.58	680	51	3.7	3.67	29	652
SAI5015_3	500 hr in GB	10.32	8.91	653	50	3.3	2.91	38	618
SAI5017_1	500 hr in L1	7.49	7.2	614	38	1.7	1.68	97	425

## 2.2 TTFQx-T1:ITIC

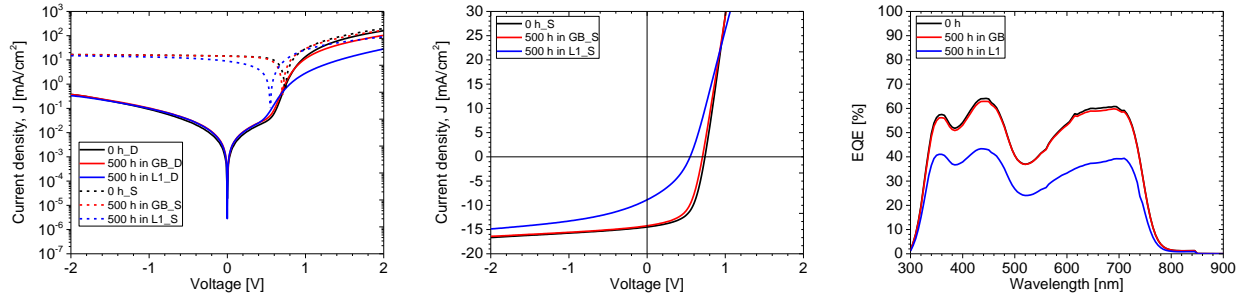


Figure S4: Dark J-V, sun J-V and EQE measurements of TTFQx-T1:ITIC based solar upon three ageing conditions.

Table S3: Solar cell parameters of TTFQx-T1:ITIC based solar upon three ageing conditions.

Sample	Ageing condition	Jsc (mA/cm <sup>2</sup> )	Jsc_EQE (mA/cm <sup>2</sup> )	Voc (mV)	FF (%)	PCE (%)	PCE_EQE (%)	Rs (Ohm)	Rp (Ohm)
SAI5024_1	0 hr	13.99	12.81	746	58	6.01	5.54	12	1238
SAI5024_1	500 hr in GB	13.90	12.65	721	56	5.58	5.11	13	1076
SAI5025_2	500 hr in L1	8.98	8.53	544	36	1.78	1.67	31	289

## 2.3 HFAQx-T:PC<sub>60</sub>BM

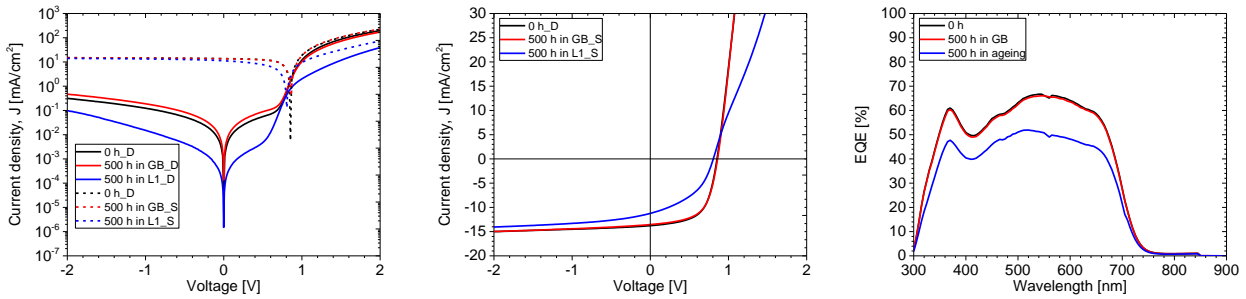


Figure S5: Dark J-V, sun J-V and EQE measurements of HFAQx-T:PC<sub>70</sub>BM based solar upon three ageing conditions.

Table S4: Solar cell parameters of HFAQx-T:PC<sub>70</sub>BM based solar upon three ageing conditions.

Sample	Ageing condition	Jsc (mA/cm <sup>2</sup> )	Jsc_EQE (mA/cm <sup>2</sup> )	Voc (mV)	FF (%)	PCE (%)	PCE_EQE (%)	Rs (Ohm)	Rp (Ohm)
SAI5020_1	0 hr	13.46	12.41	867	60	7.02	6.45	10	1828
SAI5020_1	500 hr in GB	13.54	12.24	858	60	6.96	6.30	9	1624
SAI5019_2	500 hr in L1	11.17	9.64	801	44	3.91	3.30	24	557

## 2.4 HFAQx-T:ITIC

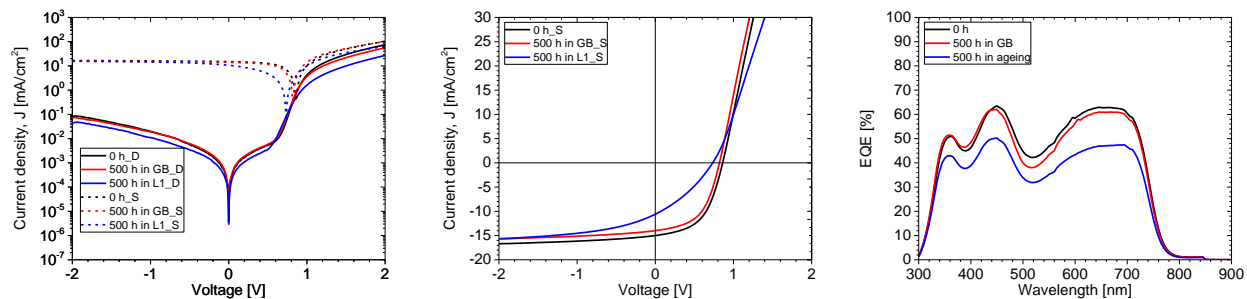
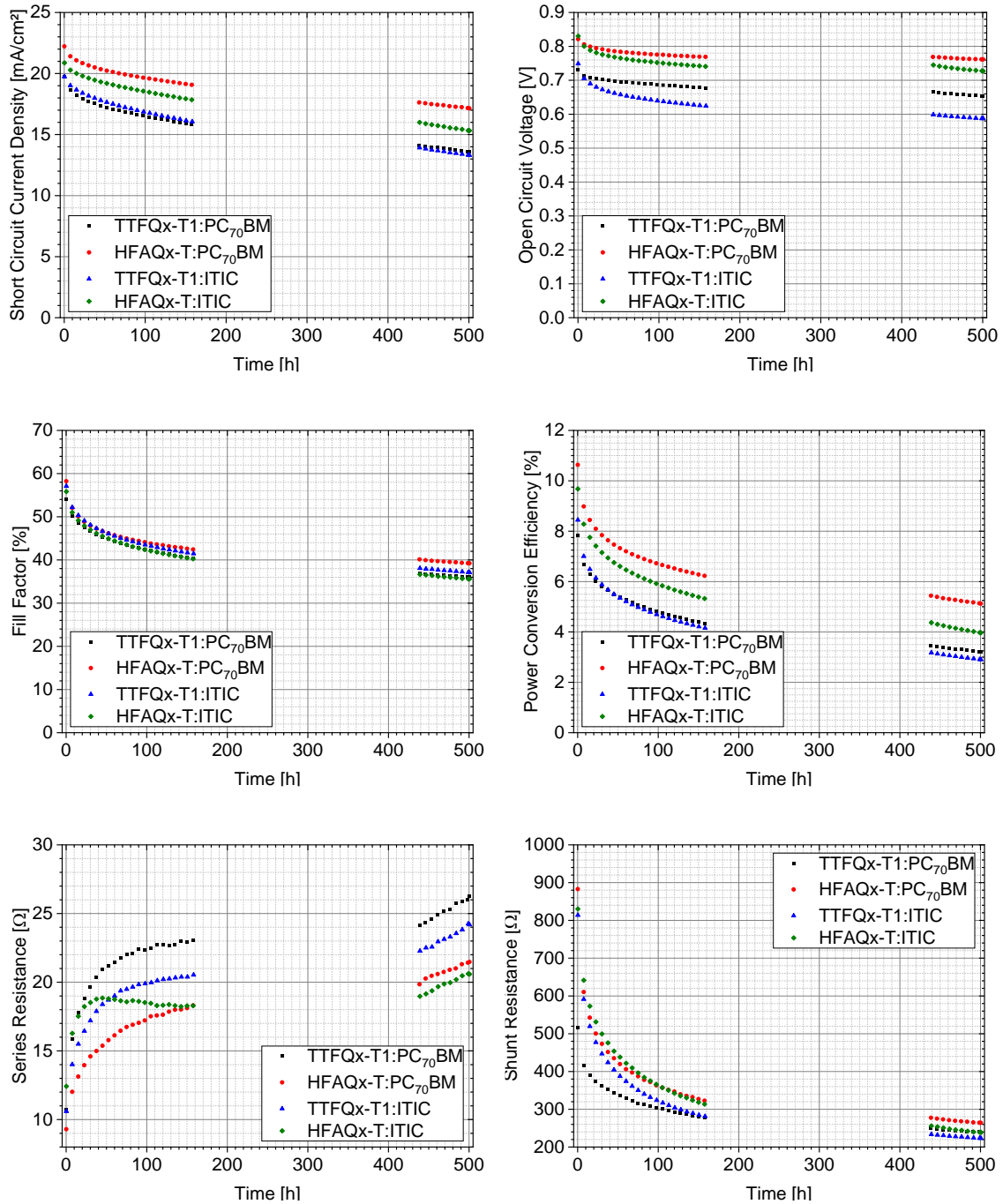


Figure S6: Dark J-V, sun J-V and EQE measurements of HFAQx-T:ITIC based solar upon three ageing conditions.

Table S5: Solar cell parameters of HFAQx-T:ITIC based solar upon three ageing conditions.

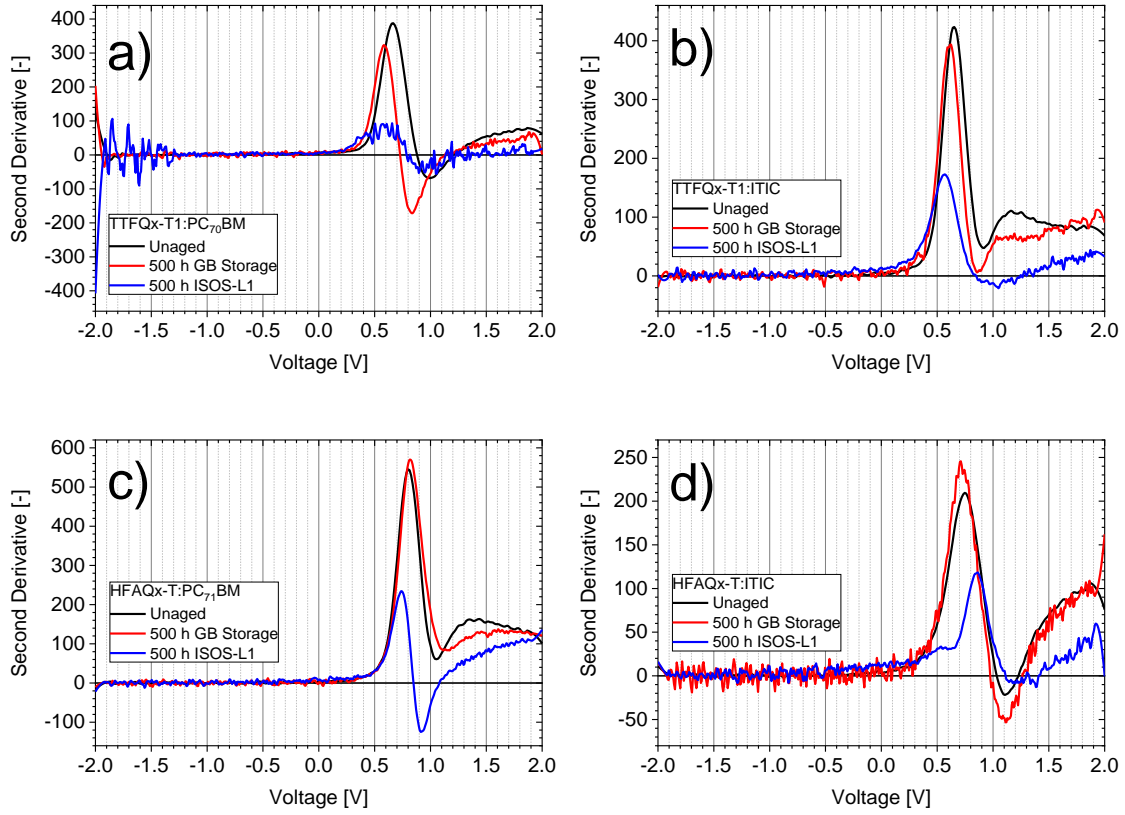
Sample	Ageing condition	Jsc (mA/cm <sup>2</sup> )	Jsc_EQE (mA/cm <sup>2</sup> )	Voc (mV)	FF (%)	PCE (%)	PCE_EQE (%)	Rs (Ohm)	Rp (Ohm)
SAI5030_4	0hr	14.09	13.31	847	54	6.41	6.09	18	1211
SAI5030_4	500 hr in GB	13.98	13.25	819	52	5.98	5.64	21	1070
SAI5027_1	500 hr in L1	10.63	10.25	767	34	2.79	2.67	30	340

## 4. Aging data



**Figure S7:** Photovoltaic parameters of the solar cells measured under continuous illumination for 500 h in ISOS-L1 setup. There was a problem with the measurement computer, so the recording of the data was interrupted.

## 5. Second derivative analysis



**Figure S8:** Second derivative analysis of the IV-Curves seen in for solar cells made from TTFQx-T1 with PC<sub>70</sub>BM (a) and ITIC (b), as well as HFAQx-T with PC<sub>70</sub>BM (c) and ITIC (d).

## 6. Extraction probability

**Table S6:** Summary of the extraction probability for aged and non-aged solar cells.

	Aging condition	Extraction probability at J <sub>sc</sub>	Extraction probability at MPP
TTFQx-T1:PC <sub>70</sub> BM	0 h	0.80924	0.59223
TTFQx-T1:PC <sub>70</sub> BM	0h in GB	0.76853	0.52854
TTFQx-T1:PC <sub>70</sub> BM	0 h in ISOS-L1	0.55602	0.33671
TTFQx-T1:ITIC	0 h	0.89407	0.71094
TTFQx-T1:ITIC	0h in GB	0.8888	0.67986
TTFQx-T1:ITIC	0 h in ISOS-L1	0.6124	0.35039
HFAQx-T: PC <sub>70</sub> BM	0 h	0.93933	0.75635
HFAQx-T:PC <sub>70</sub> BM	0h in GB	0.9325	0.7412
HFAQx-T:PC <sub>70</sub> BM	0 h in ISOS-L1	0.80754	0.52059
HFAQx-T:ITIC	0 h	0.90545	0.68887
HFAQx-T:ITIC	0h in GB	0.89805	0.66756
HFAQx-T:ITIC	0 h in ISOS-L1	0.68023	0.38996