Electronic Supplementary Information for

Oxygen-induced degradation in $AgBiS_2$ nanocrystal solar cells

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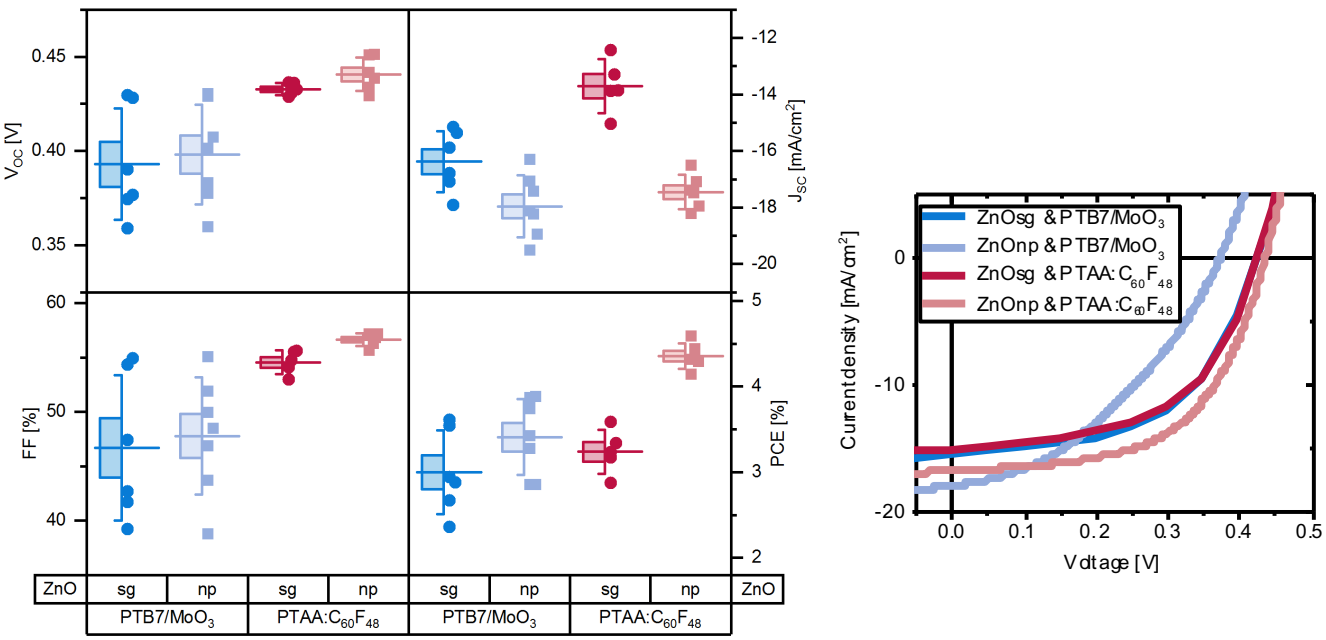

Fig. S1 left: Photovoltaic paramters after two days of dark storage, measured with 1 sun intensity for the four different comination of extraction layers and on the right: the *JV*-curves of the best performing devices for each case.

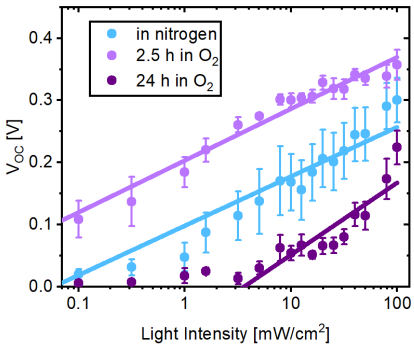

Fig. S2 Light-intensity-dependent measurements of the V_{OC} of a ZnOsg & PTAA:$C_{60}F_{48}$ $AgBiS_2$ NC SC. The first assesement is performed in nitrogen. Afterwards 20% oxygen are added to the gas flow and in the denoted time frames the second and third measurement are conducted.

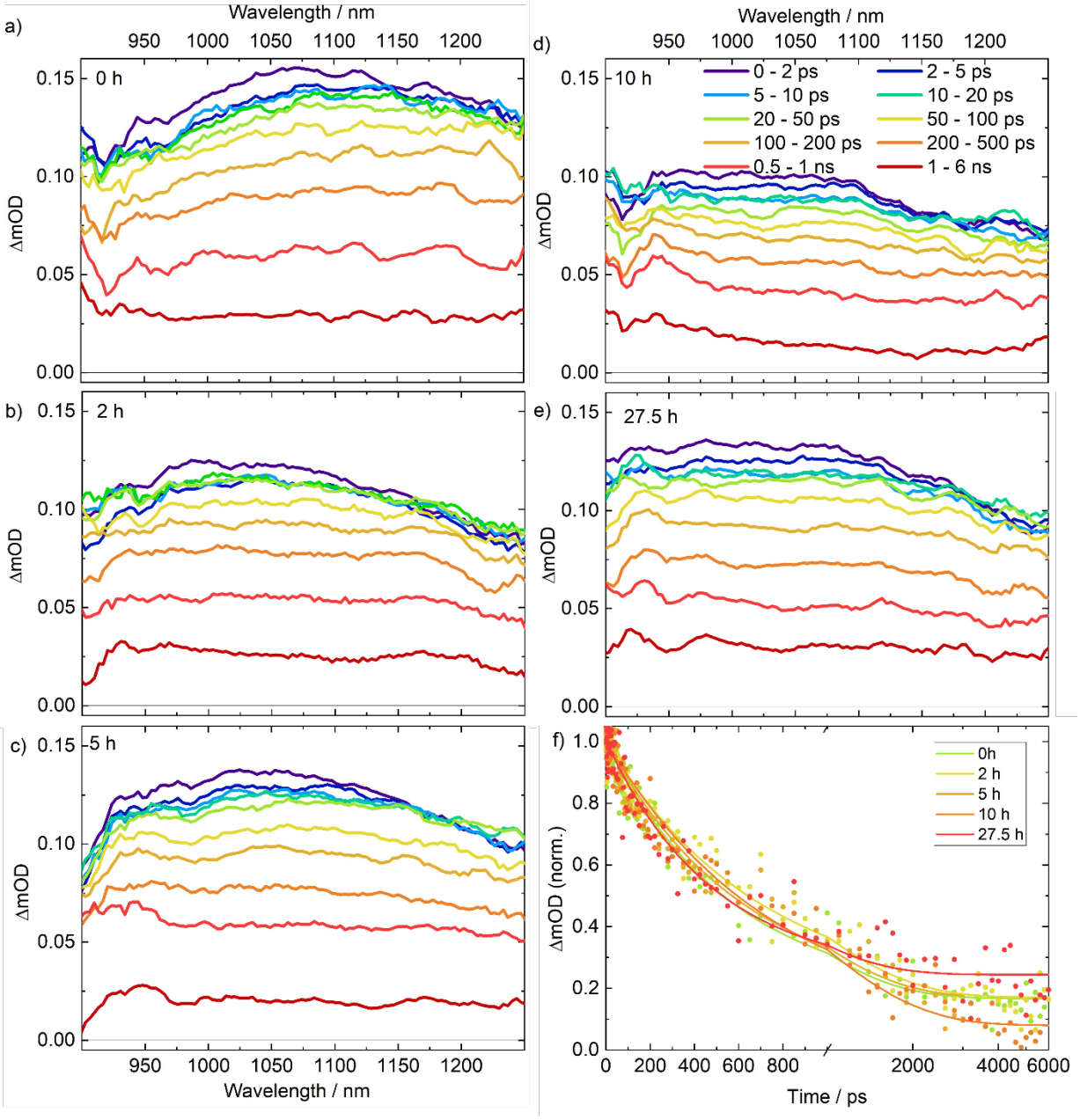

Fig. S3 a-e) transient absorption spectra for neat $AgBiS_2$ films at increasing extents of degradation, following excitation with a 700 nm pump pulse. f) Normalised kinetics averaged across PIA region for each film with monoexponential fits shown as solid lines.

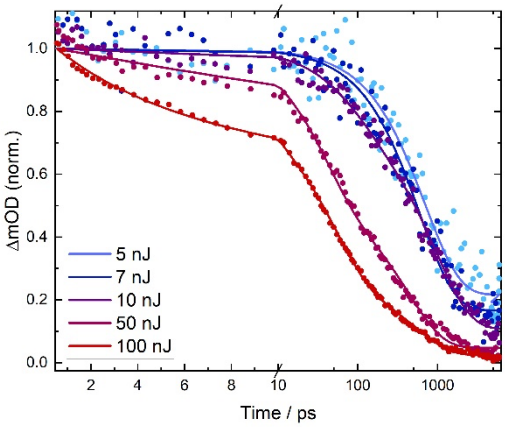

Fig. S4 Dependence of the normalised near-infrared (NIR) TA kinetics on pump intensity averaged across PIA region with a 700 nm pump wavelength. Solid lines are multiexponential fits.

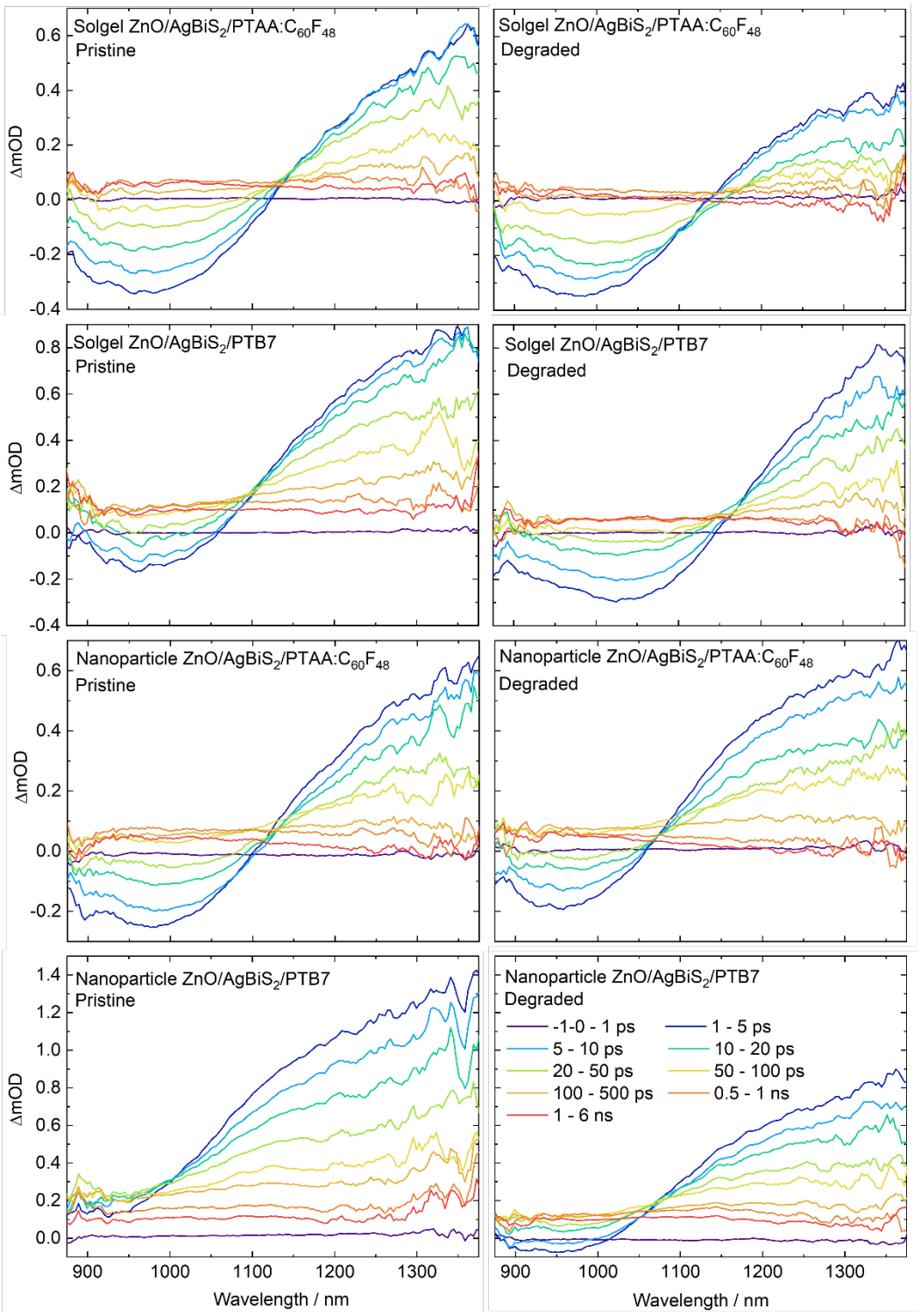

Fig. S5 TA spectra for $AgBiS_2$ devices (pumped at 700 nm) with different hole and electron transport layers, both pristine (left) and following 8 hours of degradation under light and O_2 (right).

Table S1 Atomic percentages of pristine and 24h, 20% oxygen and light degraded, 30 nm thick $AgBiS_2$-TMAI NC film on a glass/gold substrate, extracted from Fig. 2.

Orbital	Atomic %(pristine)	Atomic % (degraded)
C 1s	39.2	43.9
Ag 3d	19.6	15.1
Bi 4f	8.9	7.8
S 2p	12.1	5.5
I 3d	7.4	4.7
O 1s	11.6	20.2
Au 4f	1.2	2.9

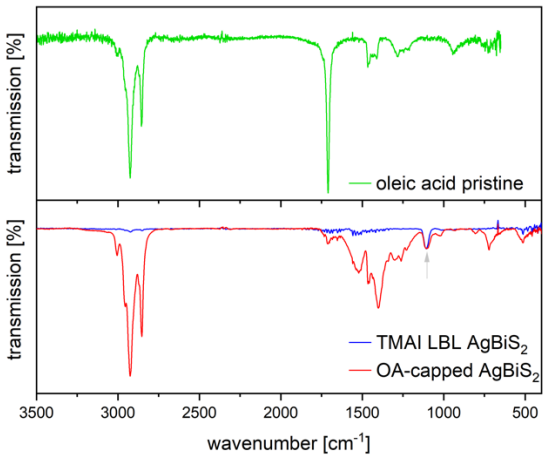

Fig. S6 FTIR measurements on TMAI and OA capped $AgBiS_2$ NCs. FTIR of OA is provided as reference.

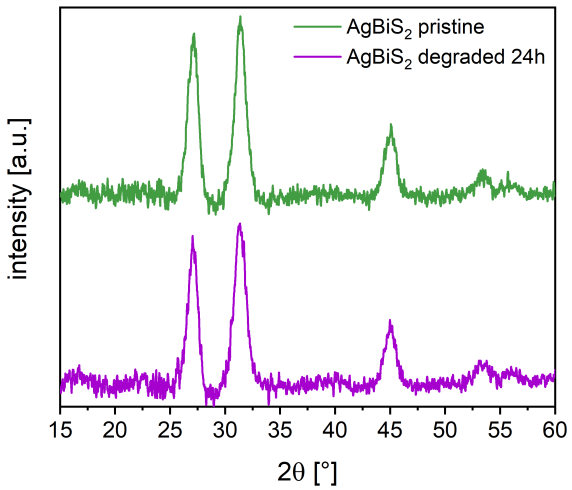

Fig. S7 XRD measurements of pristine and 24h, 20% oxygen and light degraded, $AgBiS_2$-TMAI NC films.

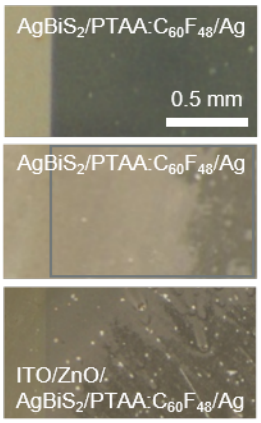

Fig. S8 Microscope images of the silver electrode (darker area) on $AgBiS_2$ NC films. Top: pristine state, the lighter part on the left is the uncovered $AgBiS_2$ NC film. Middle: degraded state after 24 h in oxygen and light, the original electrode extension is outlined. Bottom: degraded state of a full device after 24 h in oxygen and light.

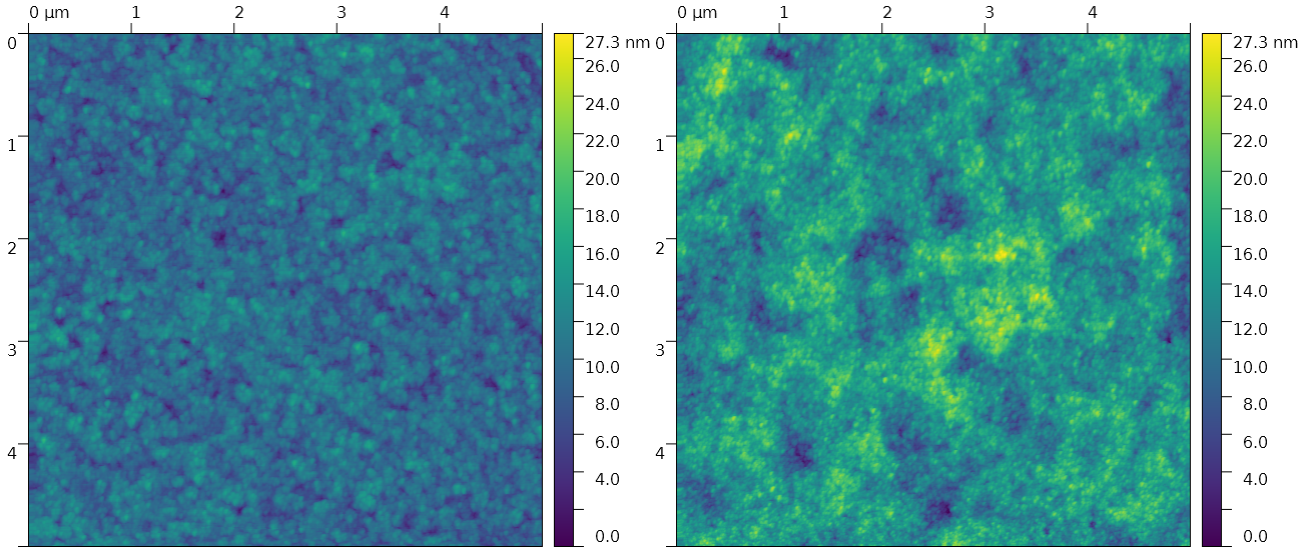

Fig. S9 Atomic force microscopy (AFM) micrographs of two different ZnO configurations (left: sg, right: np) on glass/ITO.

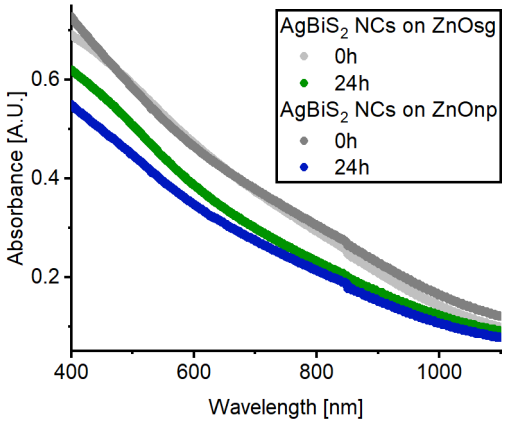

Fig. S10 Absorption measurements during degradation of an AgbiS$_2$ film on top of an ZnOsg and np film. The degradation was performed in dry air and light. Compared to Fig. 5 the absorption loss is enhanced, especially on ZnOnp. The small step at 850nm is caused by a change of grating within the measurement setup.

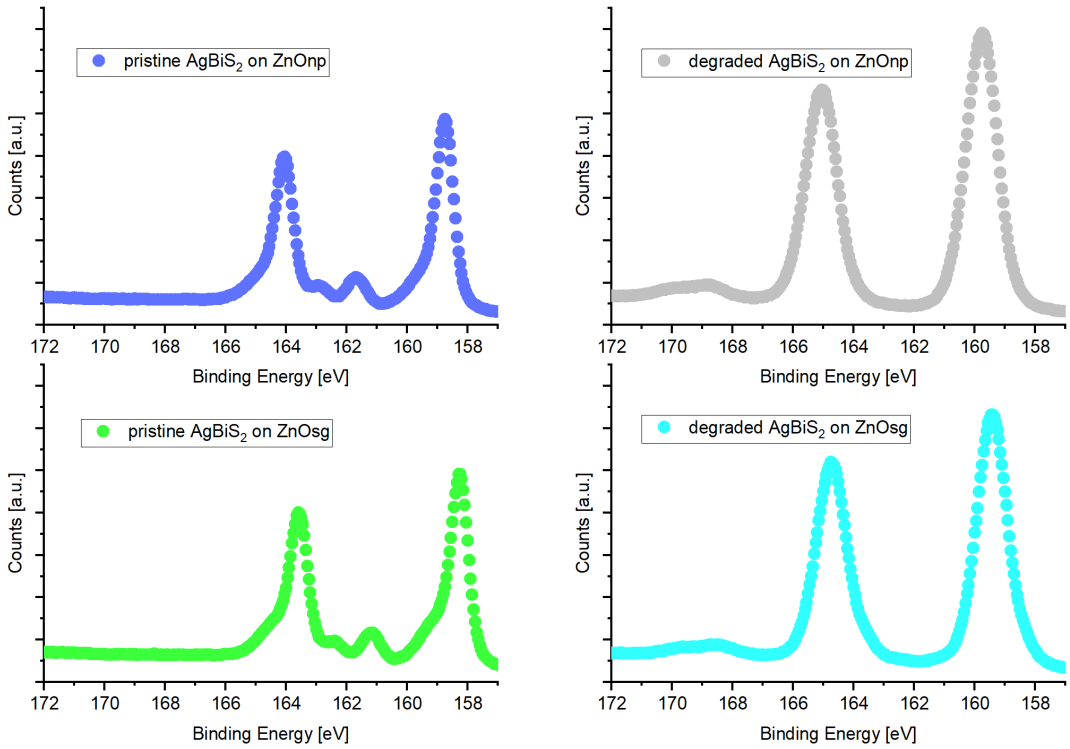

Fig. S11 XPS data of the Bi 4f orbital as a measure of the compositional degradation of a layer of AgbiS$_2$ NCs on ITO/ZnOxx during degradation. Compared to Fig. 5 the degradation after 24 h in dry air and light appears more severe, manifesting in more oxidised species.

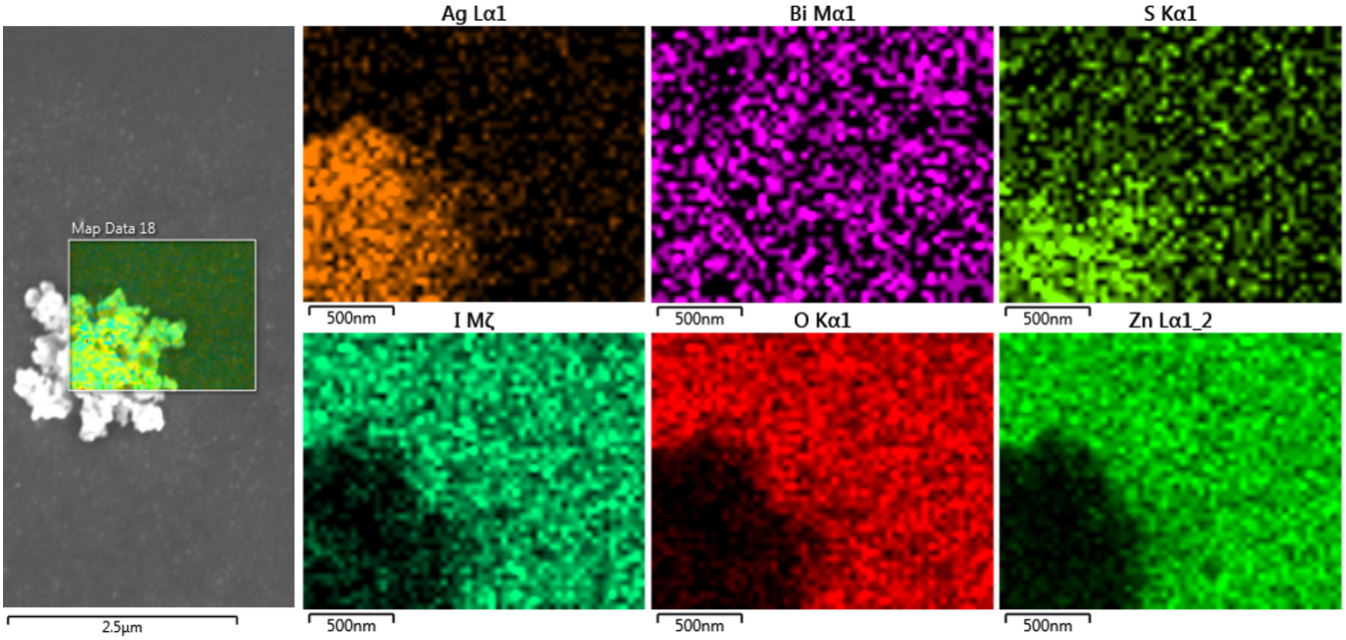

Fig. S12 EDX measurement of a aggregates appearing on the $AgBiS_2$ NC films deposited on a ZnOnp layer.

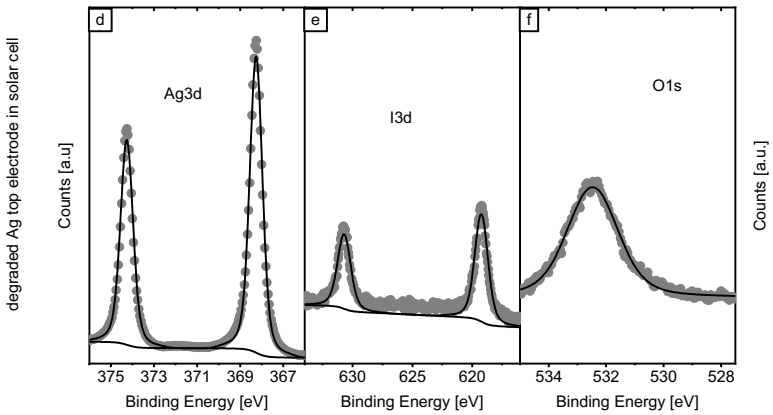

Fig. S13 XPS measurements of Ag electrodes of degraded $AgBiS_2$ NC solar cells.

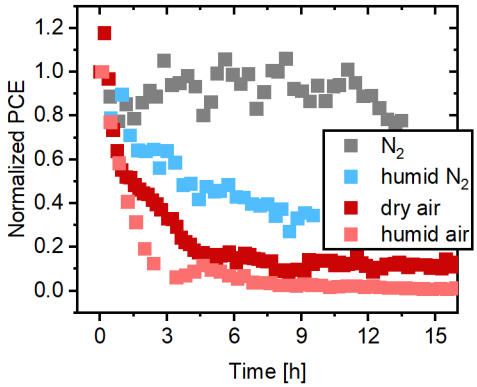

Fig. S14 Environmental stability for ZnOnp/$AgBiS_2$/PTAA:$C_{60}F_{48}$ devices under continuous 1 sun irradiation in different atmospheres. The data was normalized to the first measurement value.

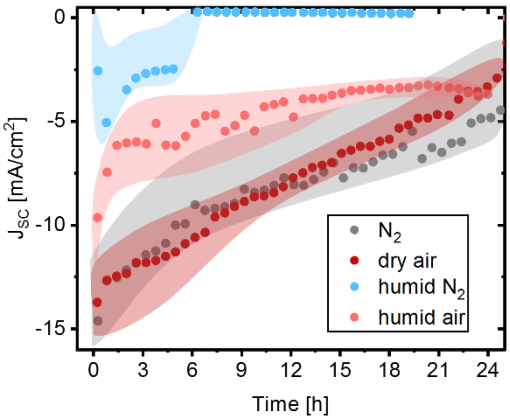

Fig. S15 J_{SC} evolution in dry air for different preconditions for ITO/ZnOsg/$AgBiS_2$-TMAI/PTAA:$C_{60}F_{48}$/Ag devices. Preconditioning was carried out for two days in the dark. The transparent shades denote the standard error of the averaged values.