Electronic Supplementary Information for

Photoinduced degradation of methylammonium lead triiodide perovskite semiconductor

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Figure S1. Spectrum of white LED.

Figure S2. X-ray photoelectron spectroscopy (XPS) survey spectra (a) and high-resolution Pb 4f spectra (b) for fresh CH$_3$NH$_3$PbI$_3$ film and CH$_3$NH$_3$PbI$_3$ degraded in vacuum/light at 350 K for 24 hours. N 1s spectra (c) for fresh CH$_3$NH$_3$PbI$_3$ film and CH$_3$NH$_3$PbI$_3$ degraded in air/light at 350 K for 24 hours.
**Figure S3.** Schematic FTO interdigital electrodes with CH$_3$NH$_3$PbI$_3$ on top.

**Figure S4.** Corresponding Tauc plot of planar FTPS of CH$_3$NH$_3$PbI$_3$ films.

**Figure S5.** Reported route of photolysis of PbI$_2$ under vacuum condition.

### Overall reaction:

\[
PbI_2 \xrightarrow{\text{light}} PbI_2 + e + h \\
2e + V_{I^-} \xrightarrow{\text{trapped}} 2e (V_{I^-}) \\
2h (V_{Pb}^{2+}) + 2I^- \xrightarrow{\text{photolysis}} I_2 \\
c (V_{I^-}) + Pb^{2+} \xrightarrow{\text{trapped}} Pb^+ + 2I^- + V_{Pb}^{2+} \\
2Pb^+ \xrightarrow{\text{vacuum}} Pb^0 + Pb^{2+} \\
\]

**Overall reaction:** \[
PbI_2 \xrightarrow{\text{vacuum/ light}} Pb + I_2^{(g)}
\]
Figure S6. (a) In-situ XRD of PbI$_2$ films at 350K under vacuum/light. (b) Integrated intensity calculated from of in-situ XRD patterns of PbI$_2$ films at 350K under vacuum/light. Selected peaks assigned to PbI$_2$ (2θ=39.5°) and Pb$_0$ (2θ=36.3°).

Figure S7. X-ray diffractogram and photographs of CH$_3$NH$_3$PbI$_3$ films that were degraded in N$_2$ with saturated H$_2$O for 24 h at 350 K (a). XPS of fresh CH$_3$NH$_3$PbI$_3$ and CH$_3$NH$_3$PbI$_3$ was degraded in N$_2$ with saturated H$_2$O for 24 h at 350 K: C 1s (b) and O 1s (c) binding energy regions.