

# Effects of ambient exposure on photoluminescence of Dion-Jacobson tin-based halide perovskite

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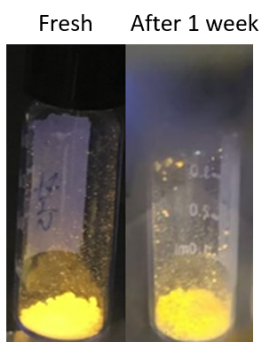
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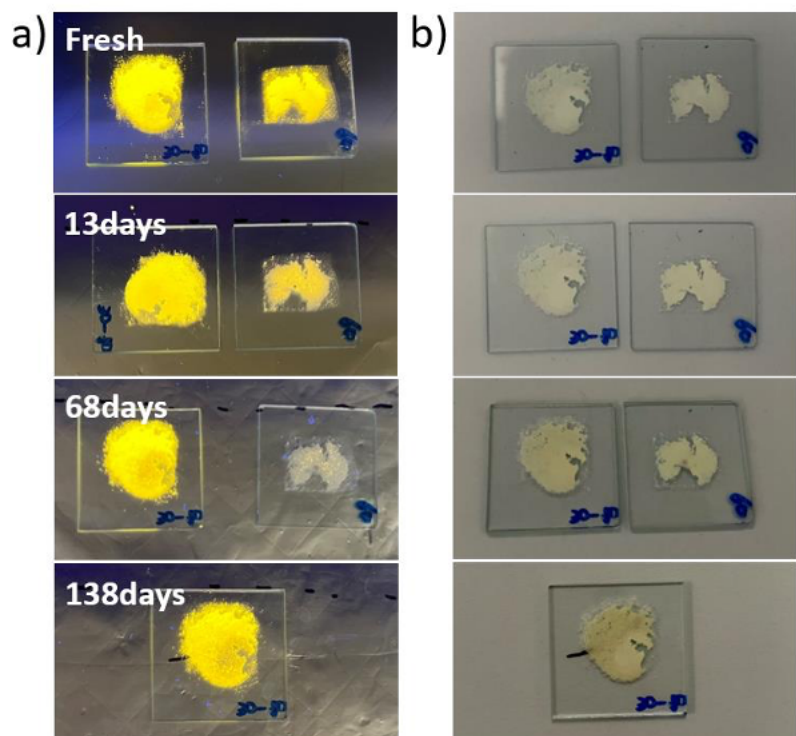
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#These authors contributed equally.

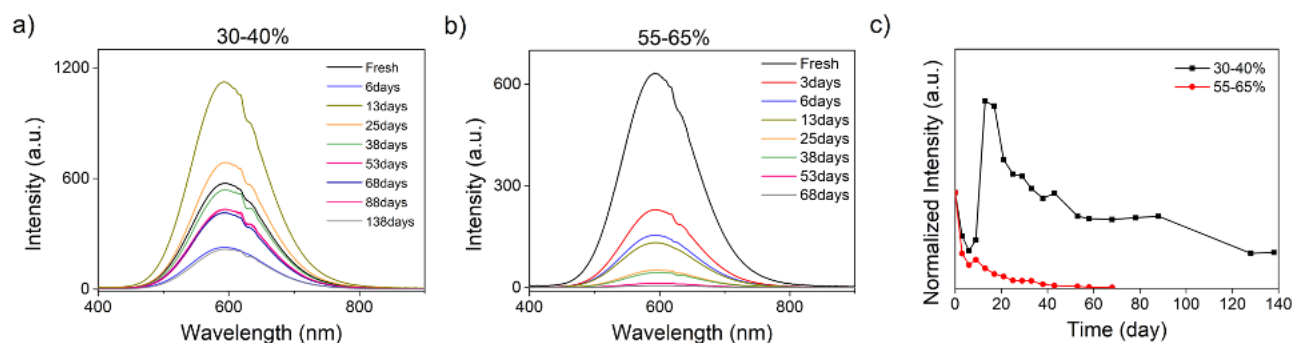
## SUPPLEMENTARY INFORMATION



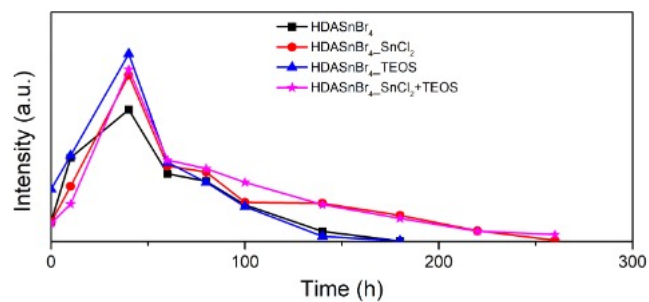
**Figure S1.** Photos of HDASnBr<sub>4</sub> powder under UV lamp, freshly prepared (left) and after 1 week in ambient (right).



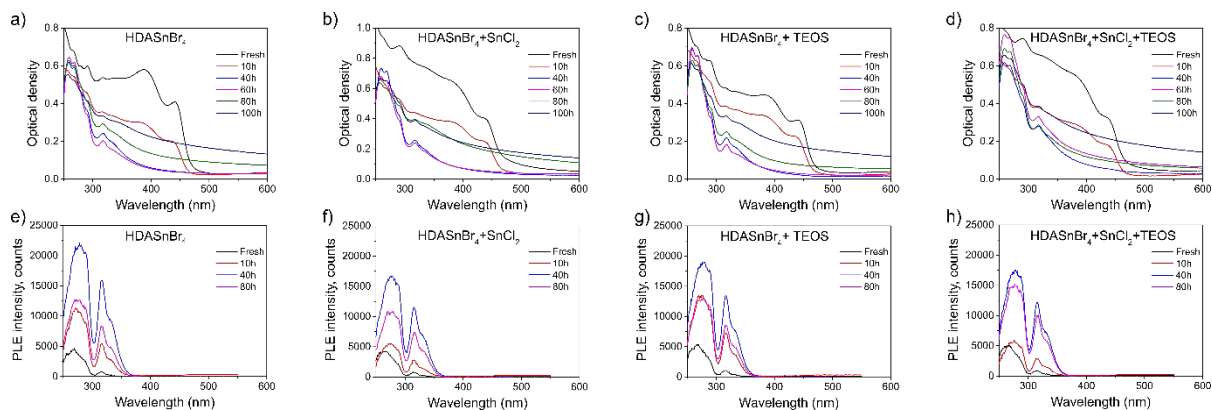
**Figure S2.** Photos of HDASnBr<sub>4</sub> powder under a) UV lamp b) ambient light at different levels of RH (30-40% RH left, 55-62%RH right) for different times of ambient exposure. The photo at 138 days includes only the sample exposed to ambient at 30-40% RH as the sample exposed to higher humidity already degraded by day 68.



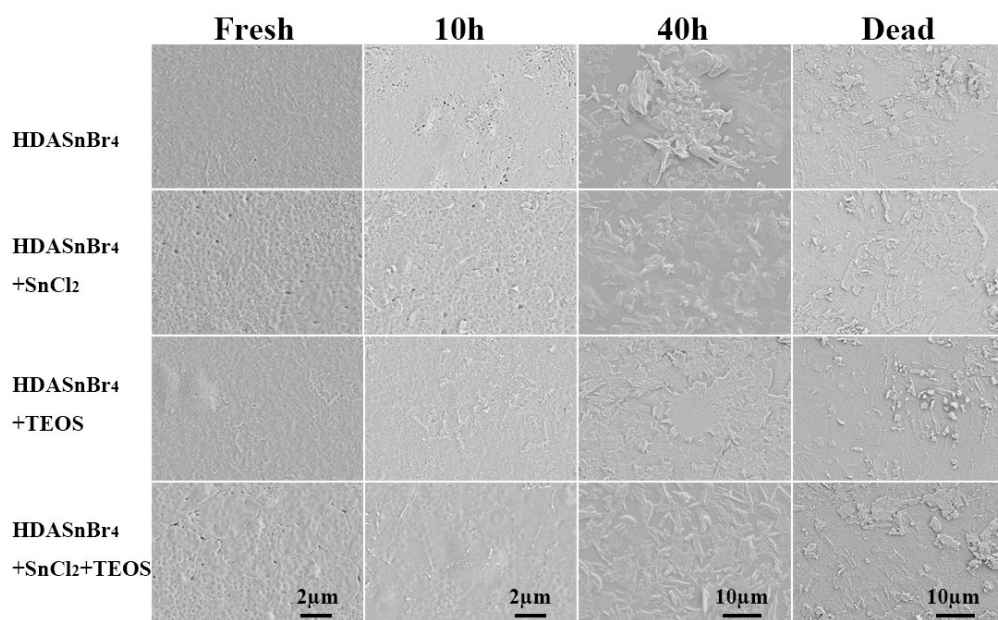
**Figure S3.** PL spectra of HDASnBr<sub>4</sub> powder for different times of ambient exposure at a) 30-40% RH b) 52-62% RH; c) Normalized PL intensity of HDASnBr<sub>4</sub> powder as a function of time for different relative humidity levels.



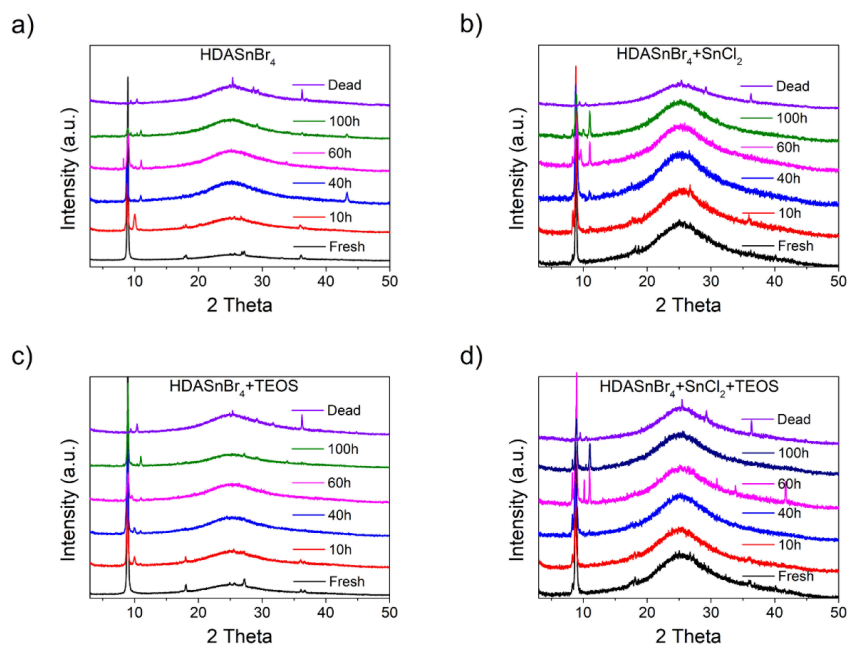
**Figure S4.** PL intensity of HDASnBr<sub>4</sub> samples with different additives as a function of time of exposure to ambient at RH of ~32-40%.



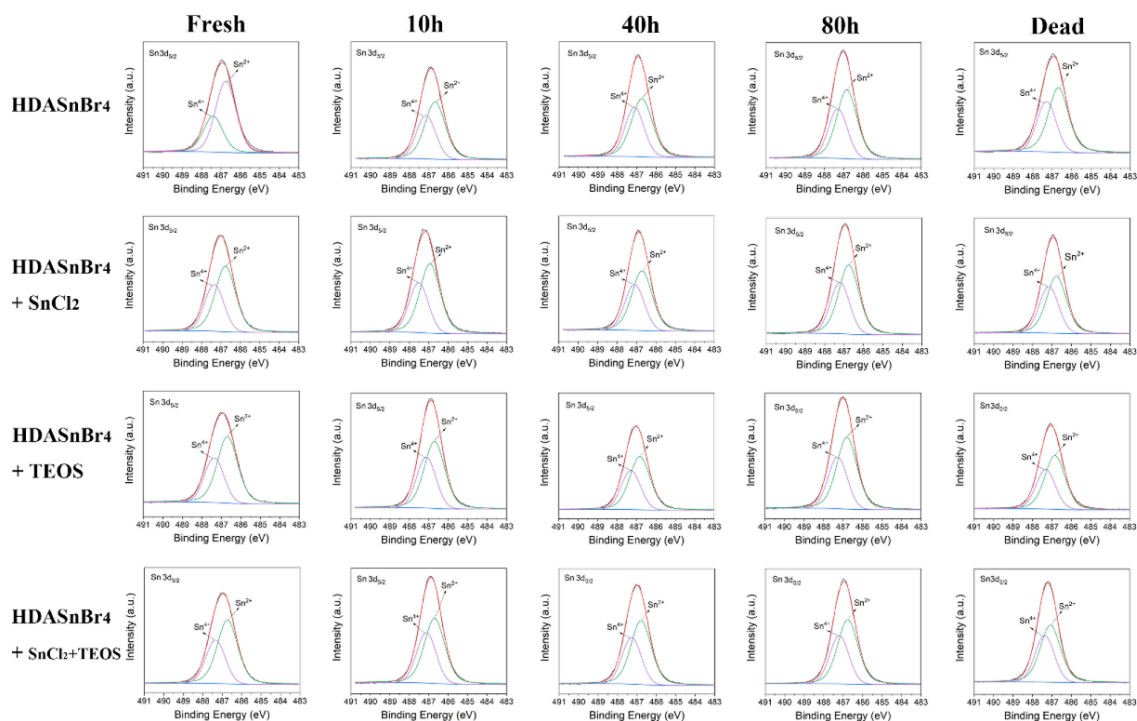
**Figure S5.** Optical density (a-d) and PLE (e-h) spectra of the samples prepared in DMF:DMSO=3:1, and exposed to ambient atmosphere with RH in the range of ~32-40% highlighting the changes in optical properties during aging.



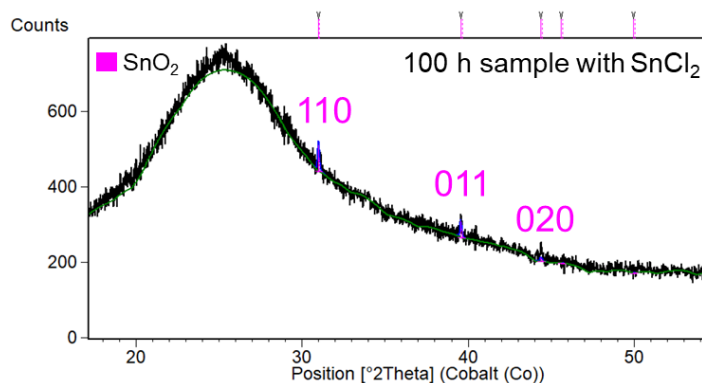
**Figure S6.** SEM images of HDASnBr<sub>4</sub> samples with different additives for different times of ambient exposure.



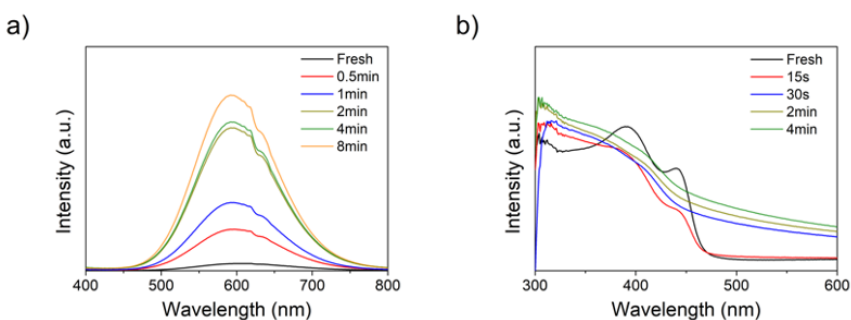
**Figure S7.** XRD patterns of HDASnBr<sub>4</sub> samples with different additives: a) no additive, b) 10%SnCl<sub>2</sub>, c) 7.5%TEOS, and d) SnCl<sub>2</sub>+TEOS for different times of ambient exposure. Films were prepared in DMF:DMSO=3:1, and exposed to ambient atmosphere with RH in the range of ~32-40%.



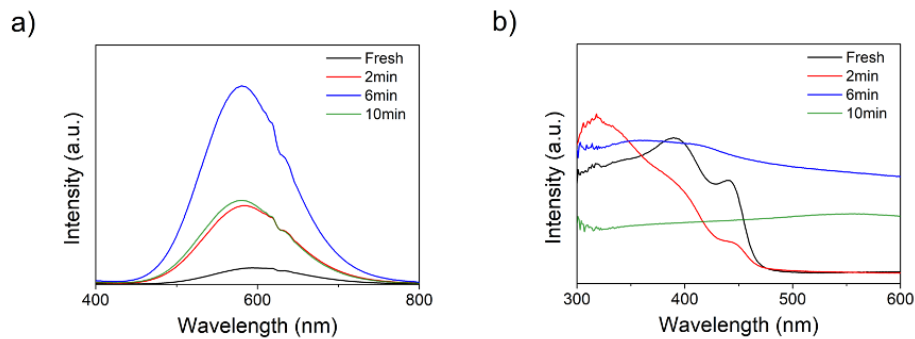
**Figure S8.** XPS spectra of Sn 3d<sub>5/2</sub> of HDASnBr<sub>4</sub> samples with different additives for different times of ambient exposure.



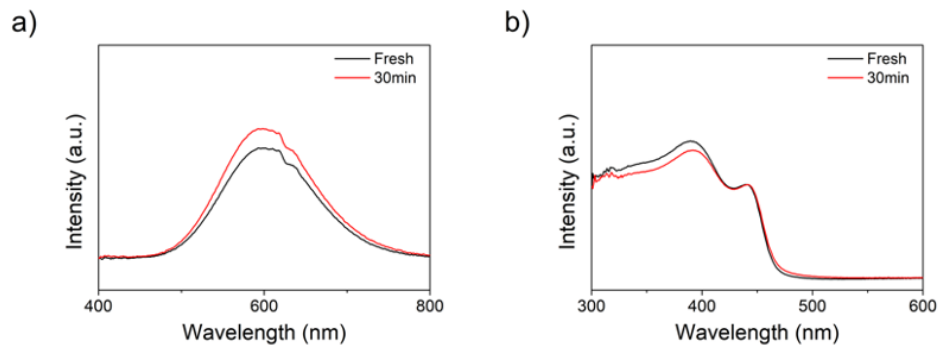
**Figure S9.** An enlarged part of XRD pattern of sample with 10% SnCl<sub>2</sub> aged for 100 h in ambient.



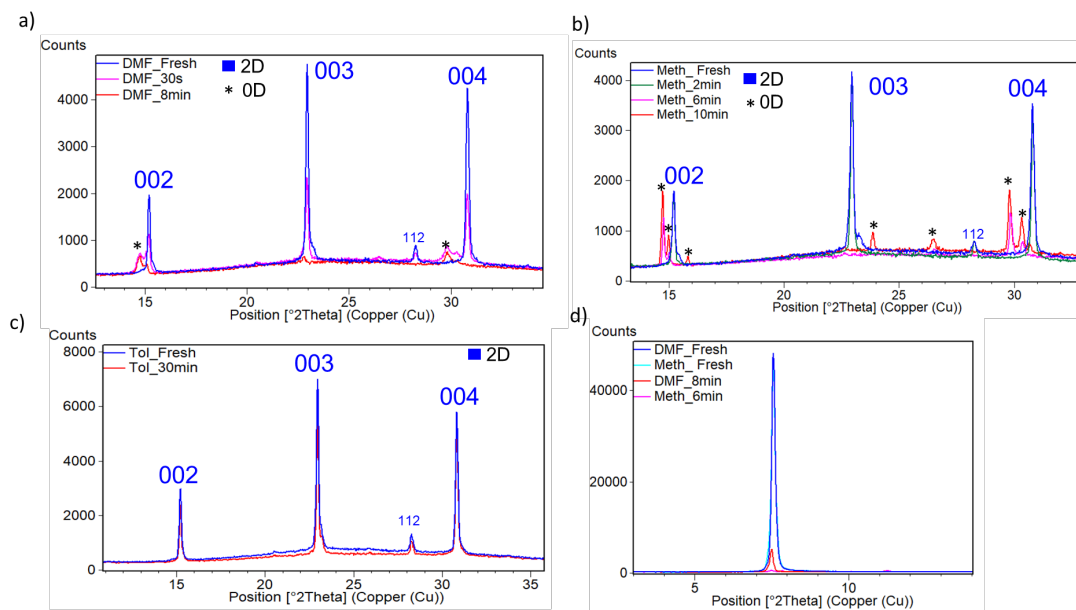
**Figure S10.** a) PL spectra and b) absorption spectra of HDASnBr<sub>4</sub> for different time of exposure for DMF vapor.



**Figure S11.** a) PL spectra and b) absorption spectra of HDASnBr<sub>4</sub> for different time of exposure for methanol vapor.



**Figure S12.** a) PL spectra and b) absorption spectra of HDASnBr<sub>4</sub> for different time of exposure for toluene vapor.



**Figure S13.** XRD patterns of HDASnBr<sub>4</sub> films exposed to a) DMF, b) methanol, and c) toluene vapors d) low angle part of XRD patterns for samples exposed to DMF and methanol