Supporting Information

Unravelling the environmental degradation mechanism of perovskite thin films

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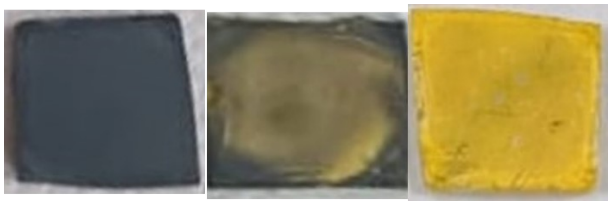

Day 1 **Day 11** **Day 21**

Fig. S1(a-c) Digital photographs of $MAPbI_3$ films deposited on glass and stored under ambient conditions for several days. The black-colored film observed on day 1 corresponds to the fresh $MAPbI_3$ thin film. The formation of a yellow-colored film on day 21 corresponds to the experimentally observed PbI_2 phase after degradation.

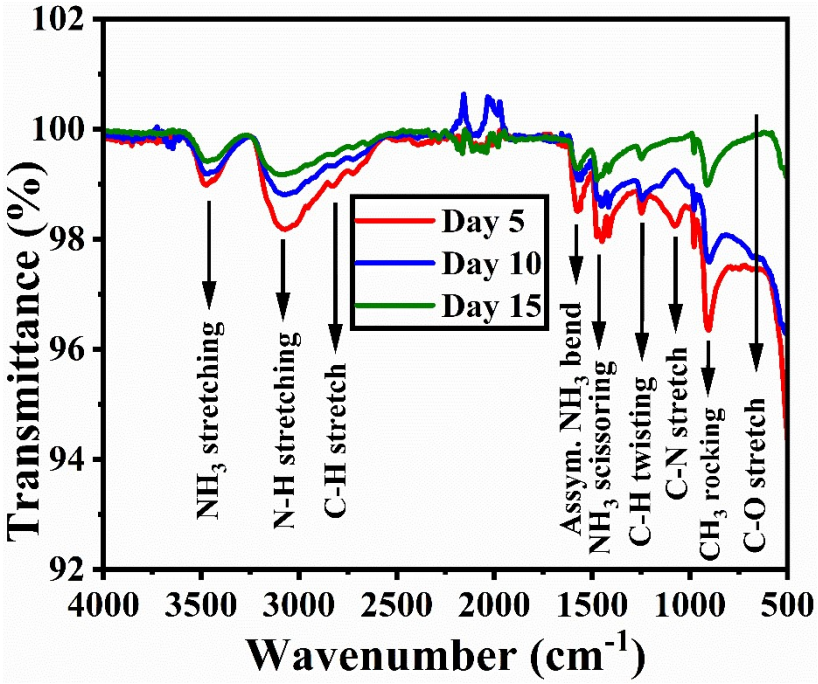

Fig. S2 FTIR spectra for degradation study at various intervals on $MAPbI_3$ thin film

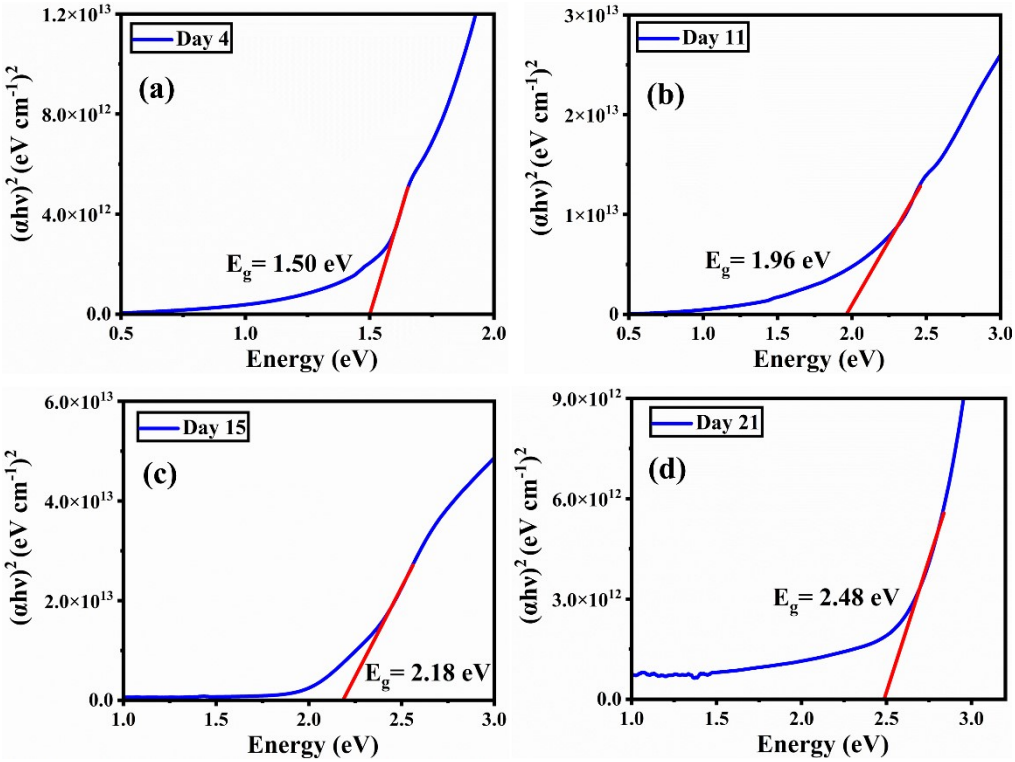

Fig. S3(a-d) Tauc's plot for $MAPbI_3$ aged thin films were obtained over a period of 21 days at regular intervals for day 4,11,15 and 21 under ambient conditions.

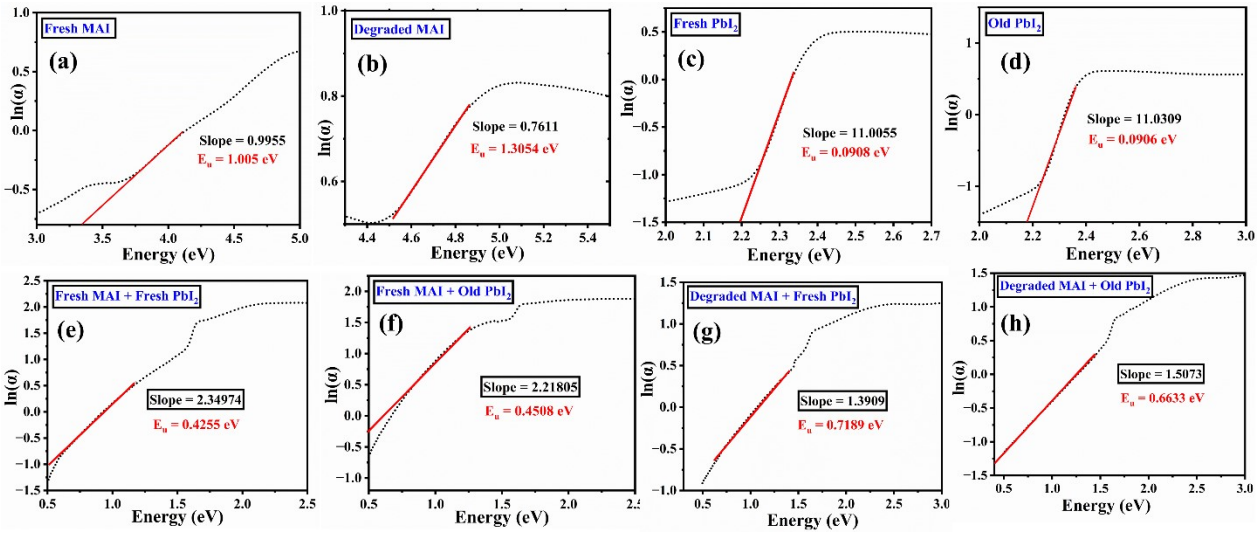

Fig. S4 Urbach energy plot for fresh and old MAI and PbI_2 powders and thin films. a. fresh MAI, b. degraded MAI, c. fresh PbI_2, d. old PbI_2, e. fresh MAI + fresh PbI_2, f. fresh MAI + old PbI_2, g. degraded MAI + fresh PbI_2 and h. degraded MAI + old PbI_2.

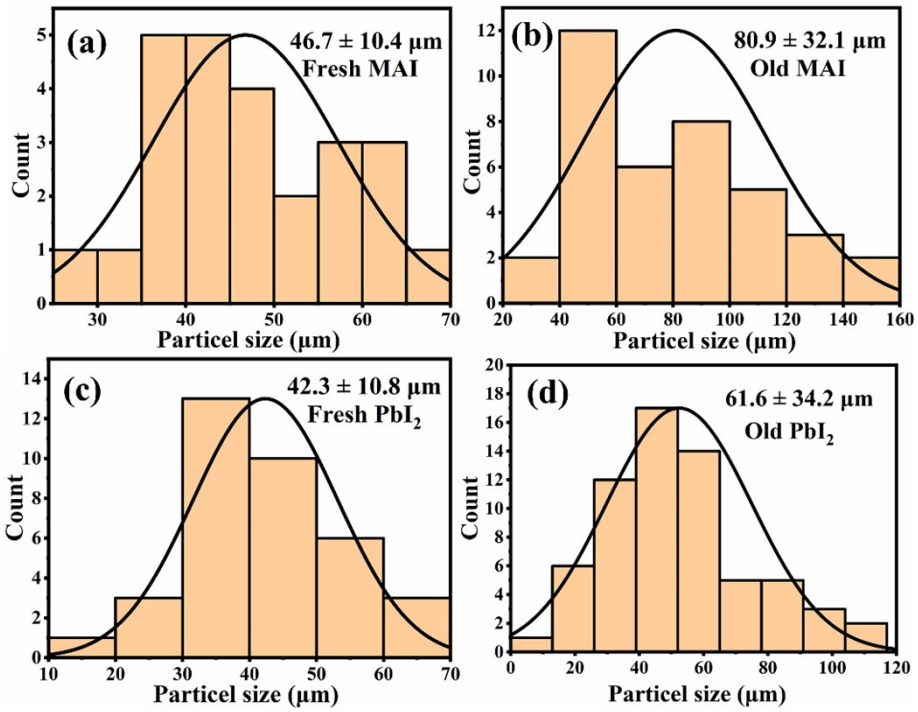

Fig. S5 Histogram of particle size distributions of synthesized MAI and PbI_2 precursor powders were calculated for both fresh and old samples. (a) fresh MAI powder (b) old MAI powder, (c) fresh PbI_2 powder and (d) old PbI_2 powder

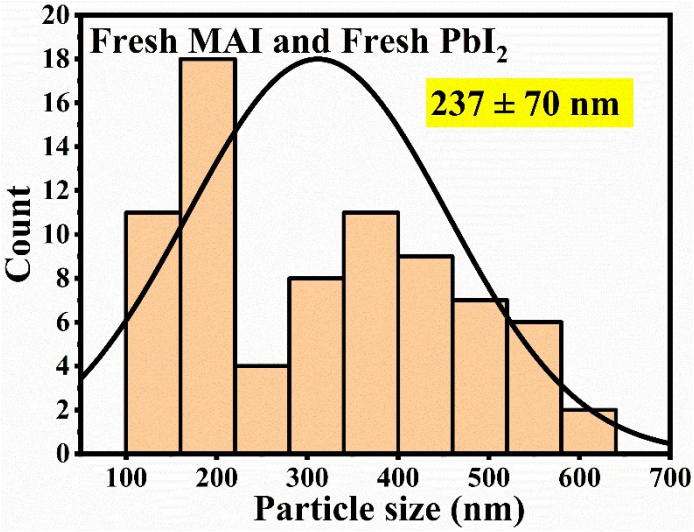

Fig. S6 Using ImageJ software, a histogram of the grain size distributions for the freshly prepared $MAPbI_3$ thin film was calculated, showing an average grain size of ~ 237 nm.

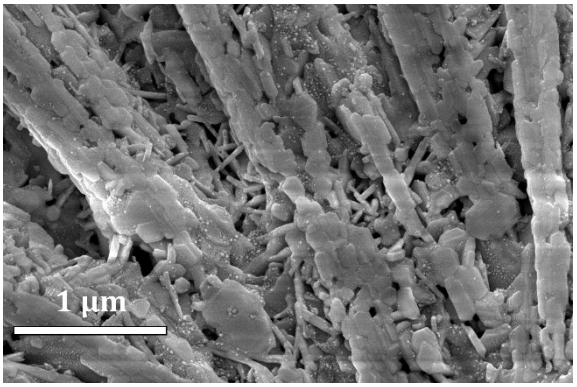

Fig. S7 SEM image for the degraded $MAPbI_3$ thin film shows the flake-like structure with hexagonal morphology, which was obtained on day 21 when exposed to ambient conditions.

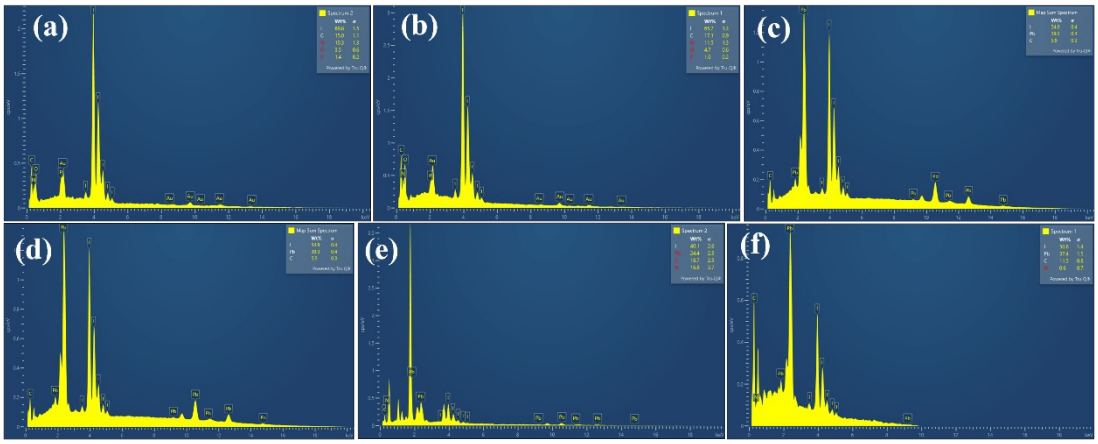

Fig. S8 (a-f): Elemental composition obtained from EDS spectrum of fresh and old synthesized MAI and PbI_2 precursor powders and the EDS spectrum was also obtained for both fresh and degraded $MAPbI_3$ thin films exposed to ambient conditions (a) fresh MAI (b) old MAI, (c) fresh PbI_2, (d) old PbI_2, (e) fresh $MAPbI_3$ thin film; (f) degraded $MAPbI_3$ thin film.

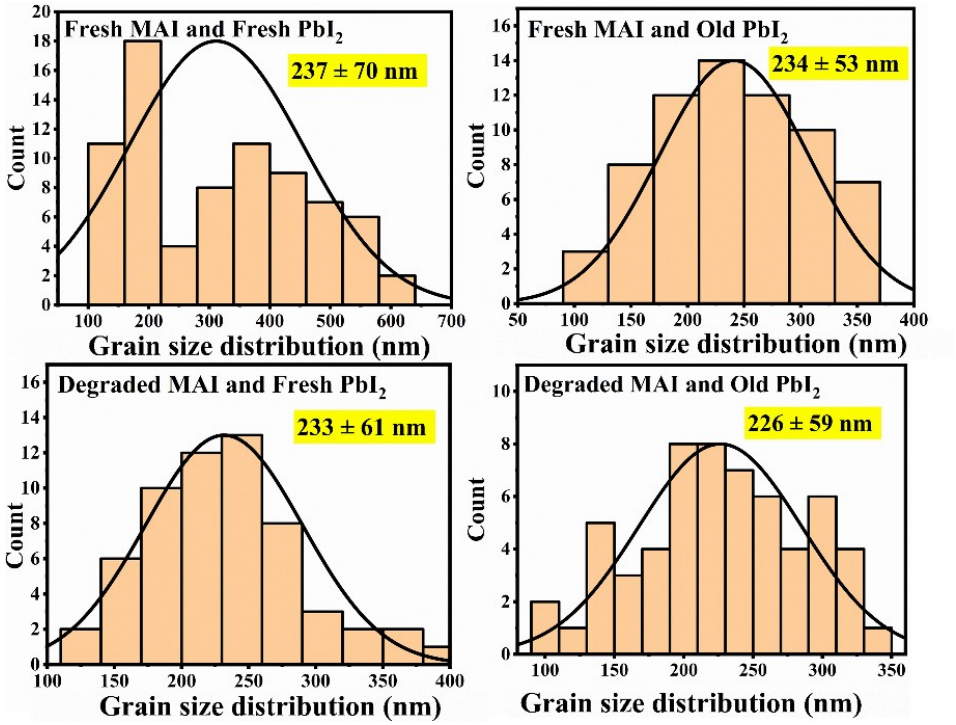

Fig. S9 Using ImageJ software, a histogram of the grain size distributions for fresh and old MAI and PbI_2 powders. a. fresh MAI + fresh PbI_2, b. fresh MAI + old PbI_2, c. degraded MAI + fresh PbI_2 and d. degraded MAI + old PbI_2.

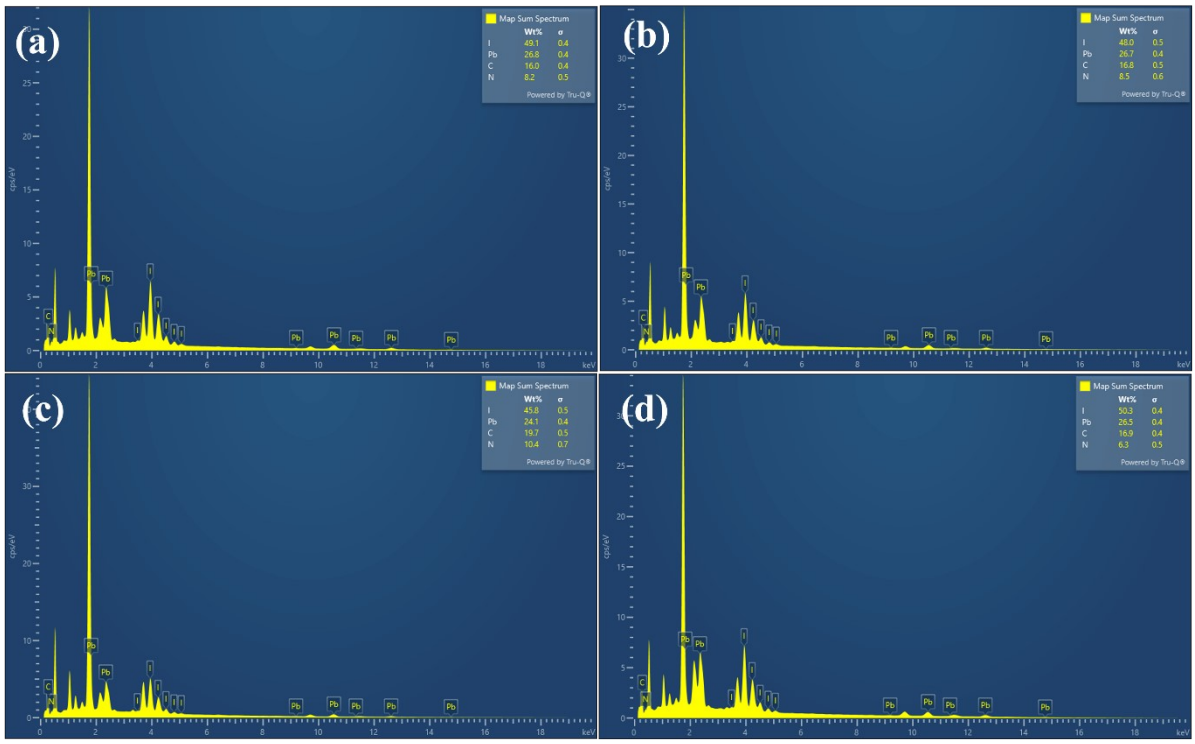

Fig. S10 The elemental composition obtained from EDS spectrum for the thin films prepared using fresh and old MAI and PbI_2 powders. (a). fresh MAI + fresh PbI_2, (b). fresh MAI + old PbI_2, (c). degraded MAI + fresh PbI_2 and (d). degraded MAI + old PbI_2

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