Supplementary Information

Stability of $MAPbI_3$ perovskite grown on planar and mesoporous electron-selective contact by inverse temperature crystallization

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Optimization of experimental parameters:

Keeping the precursor concentration at 1.23 M and annealing temperature at 110 ˚C constant, the growth duration was optimized and the results are shown in Fig. S1. As the duration of growth increased, there was improvement in the crystallinity and surface coverage of the film up to 18 hrs. When further the growth duration was increased to 24 hrs, we could not observe substantial improvement in the film coverage or crystal size, hence the growth duration of 18 hrs is considered for further experimentation.

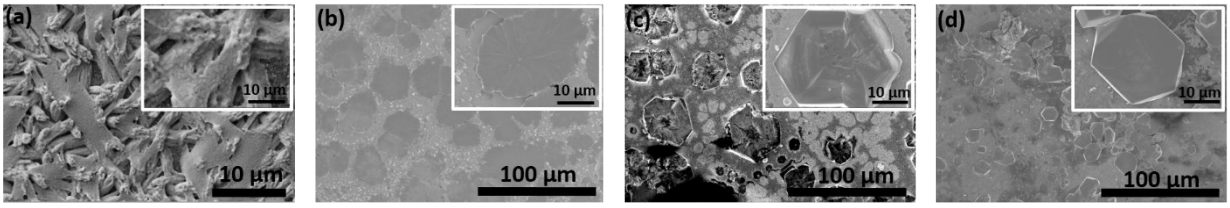

Fig. S1. FESEM images of the films grown for (a) 8 hrs, (b) 12 hrs, (c) 18 hrs, (d) 24 hrs. Inset images show their corresponding high magnification images.

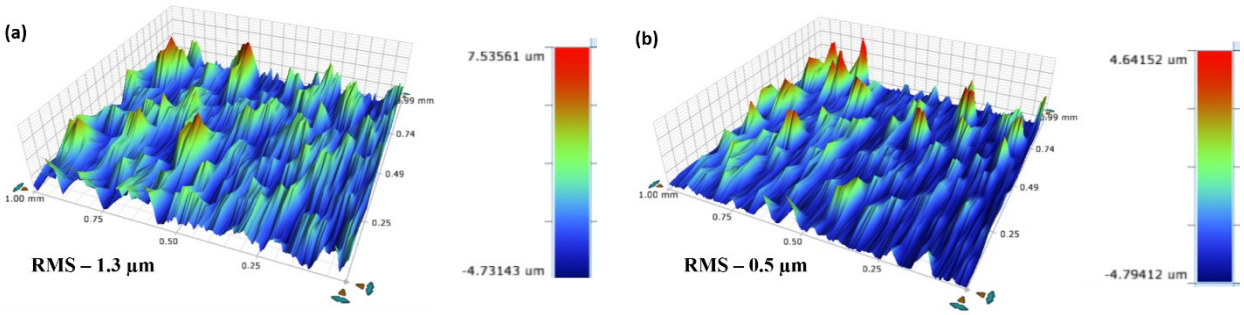

Fig. S2 (a) Surface 3D mapping images of SC-$MAPbI_3$ grown on (a) p-TiO_2 and (b) m-TiO_2. From the images, it can be concluded that the film grown on m-TiO_2 exhibited smoother profile than the film grown on p-TiO_2.

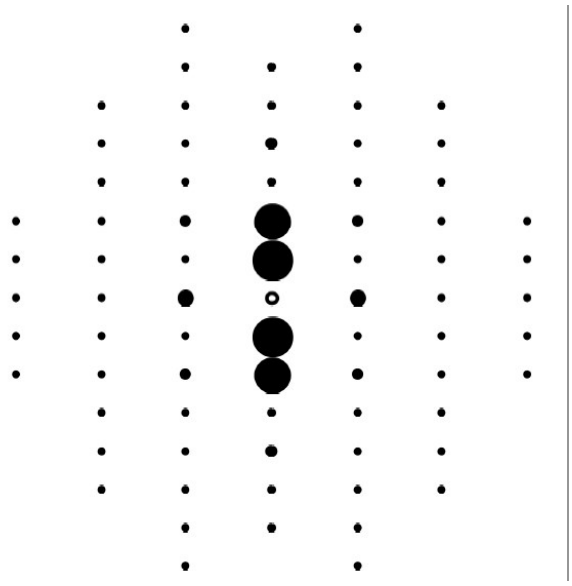

Fig. S3. Simulated electron diffraction pattern of SC-$MAPbI_3$ with [221] zone axis.

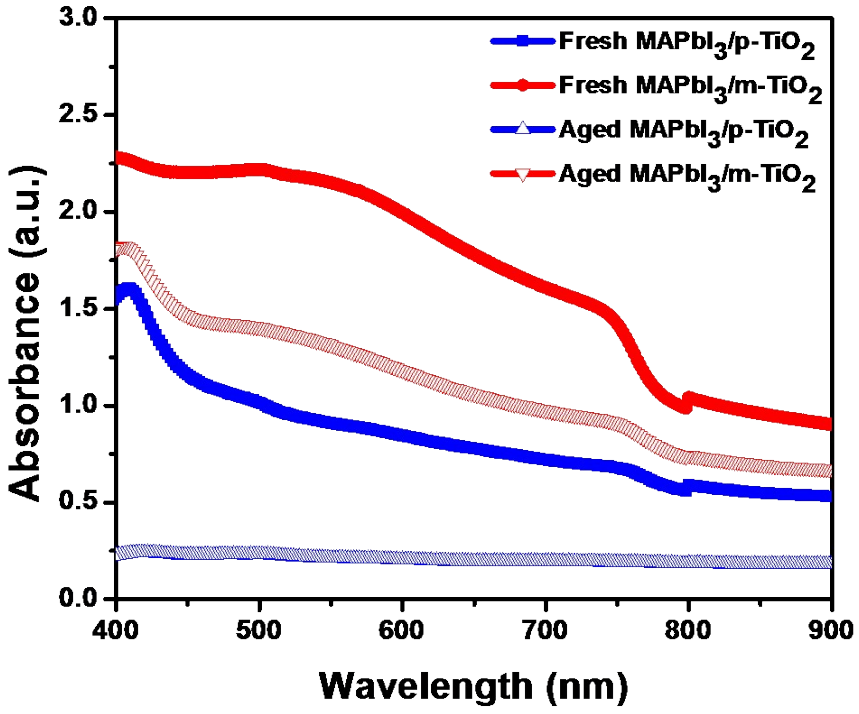

Fig. S4. Absorbance spectra of the $MAPbI_3$ fresh and aged films (5000 hrs at 30 ˚C and 50 % RH) developed on planar and mesoporous TiO_2.

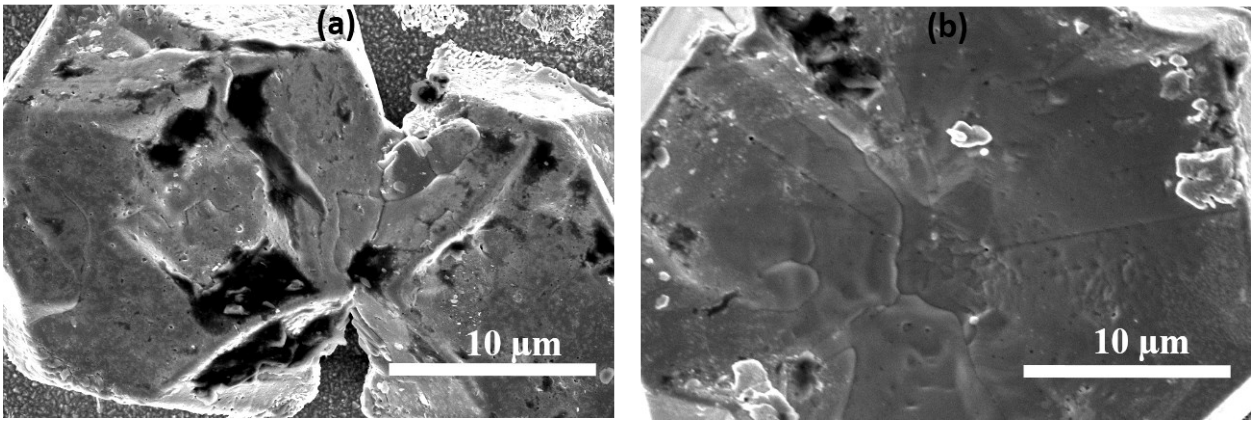

Fig. S5. FE-SEM images of the aged (5000 hrs at 30 ˚C and 50 % RH) (a) $MAPbI_3$/p-TiO_2, (b) $MAPbI_3$/m-TiO_2.

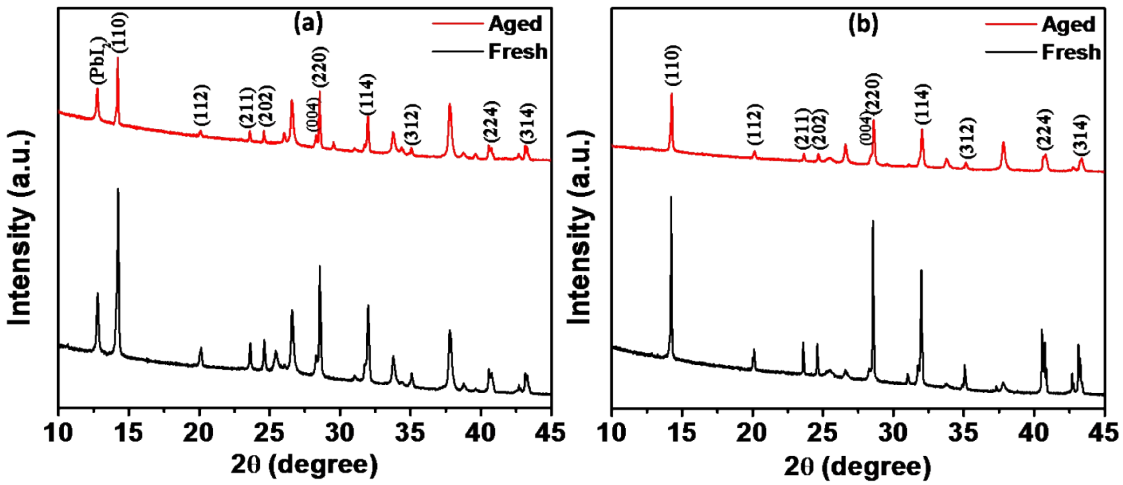

Fig. S6. XRD patterns of the $MAPbI_3$ fresh and aged films (5000 hrs at 30 ˚C and 50 % RH) developed on (a) p-TiO_2 (b) m-TiO_2.

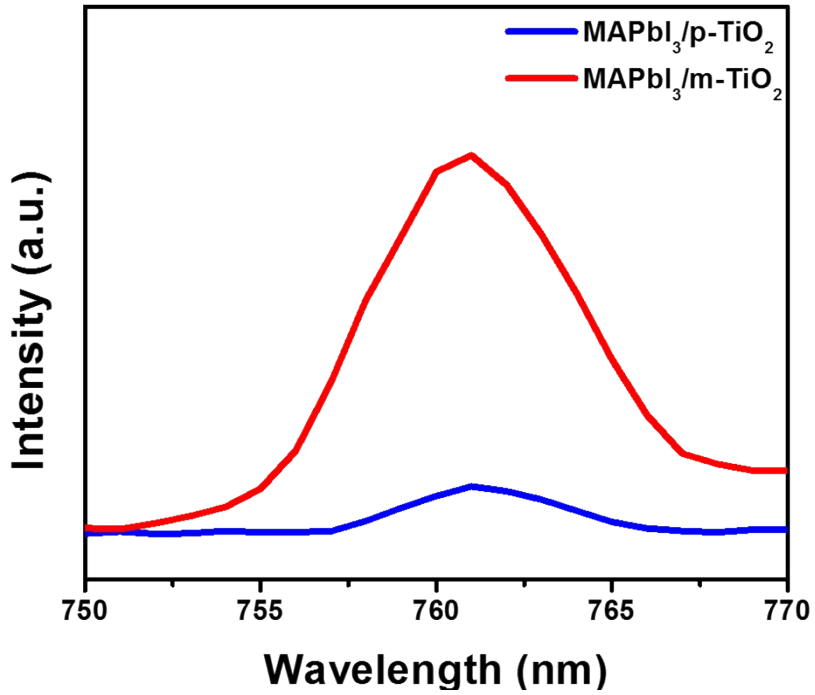

Fig. S7. Photoluminescence spectra of the $MAPbI_3$ film grown on planar and mesoporous TiO_2 layer coated substrates. The enhanced PL intensity of $MAPbI_3$ grown on mesoporous TiO_2 is plausibly attributed to reduced trap densities caused by the smoother and passivated film compared to the film grown on planar TiO_2[1–3].

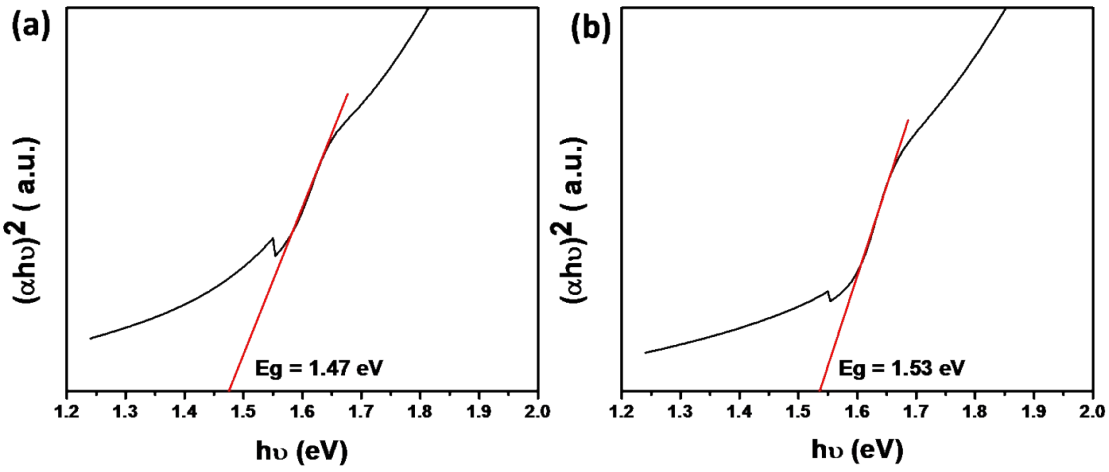

Fig. S8. Tauc plot of (a) $MAPbI_3$ on planar TiO_2 and (b) $MAPbI_3$ on mesoporous TiO_2.

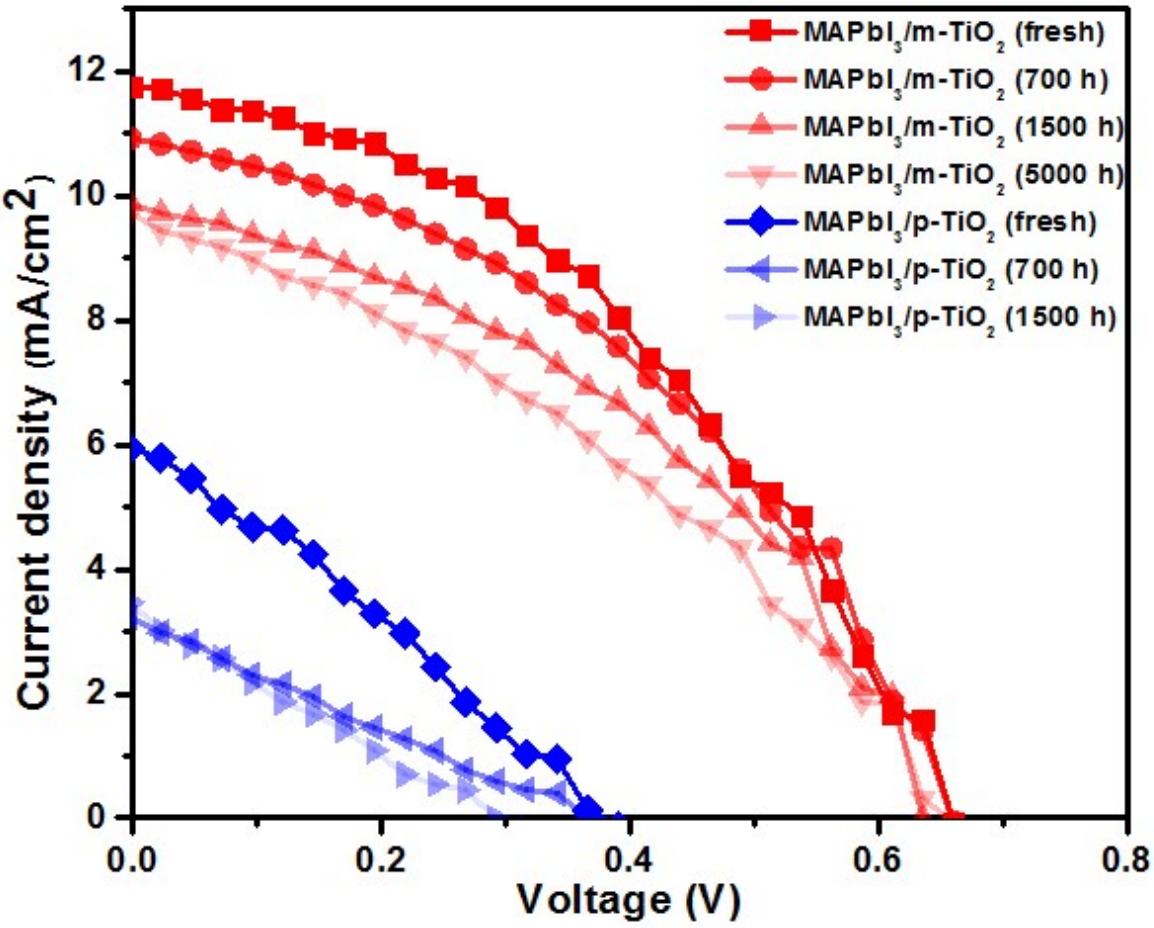

Fig. S9. Current-voltage characteristics of HTM-free $MAPbI_3$ perovskite solar cells prepared on planar and mesoporous-TiO_2 electron selective contacts with respect to ageing time in ambient conditions (30 ˚C and 50 % RH).

References:

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