

# Radiation induced structural phase transition and damage in methyl ammonium lead perovskites studied by focused-beam synchrotron x-ray diffraction

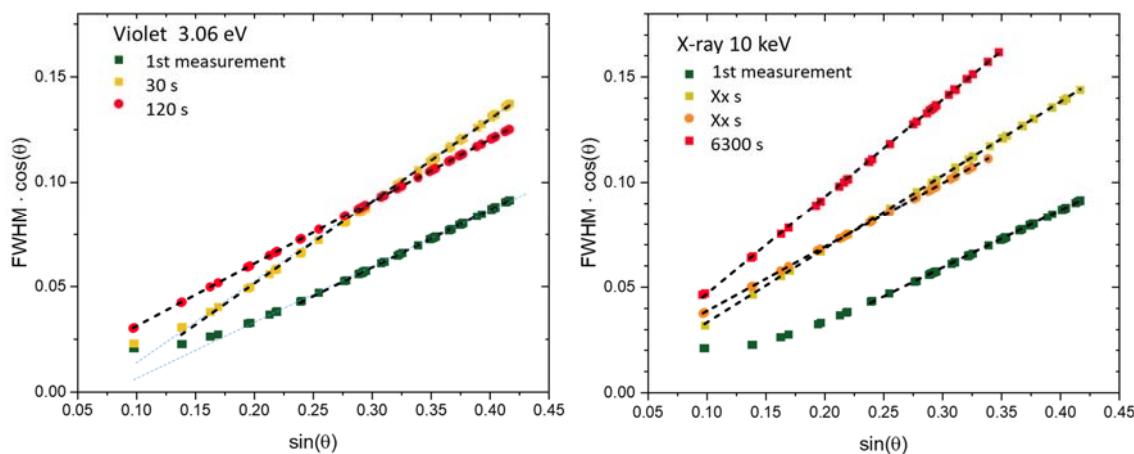
## Supporting Information

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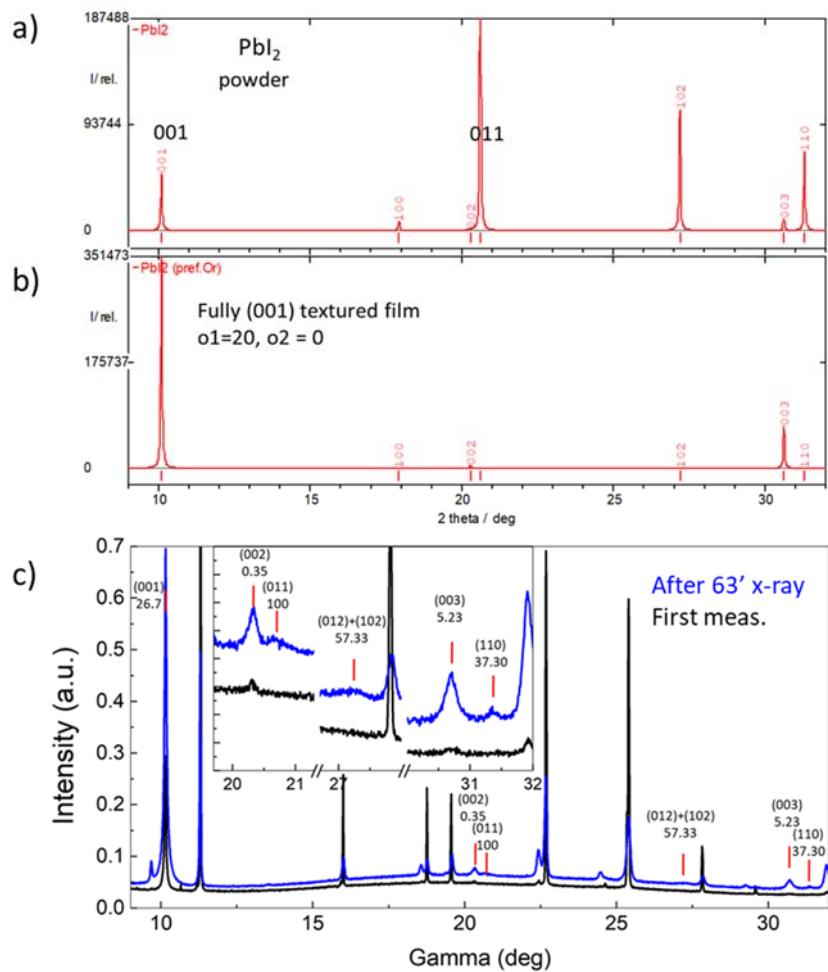
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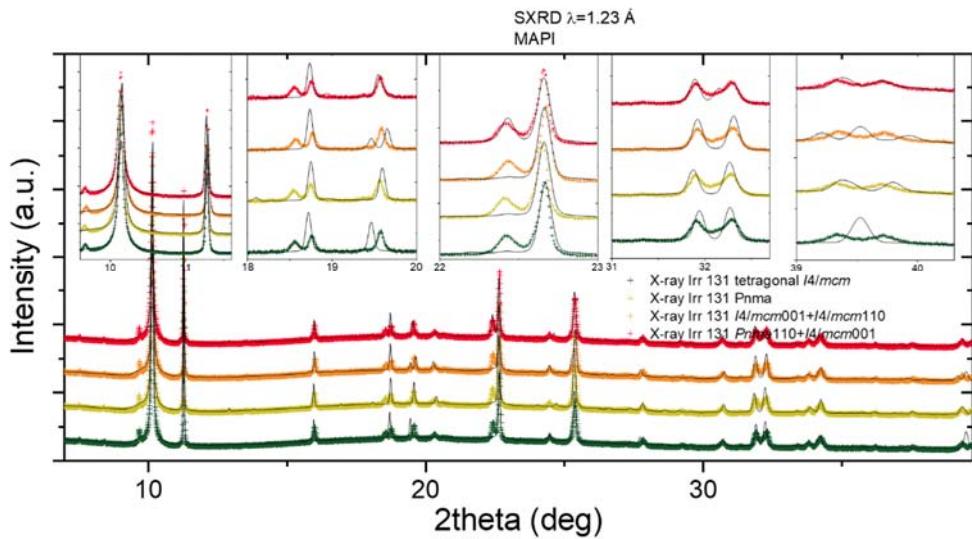


**Figure S1.** Williamson-Hall plots of the patterns corresponding to violet (3.06 eV) and X-ray (10 keV) irradiated films that serve to evaluate crystal size and microstrain. The deviation from the dashed blue lines in the left panel evidence that the width of the lowest angle peaks of the less damaged samples are limited by the instrumental resolution but it is important to note that the slope is artificially increased by the sample damage occurring while measuring.

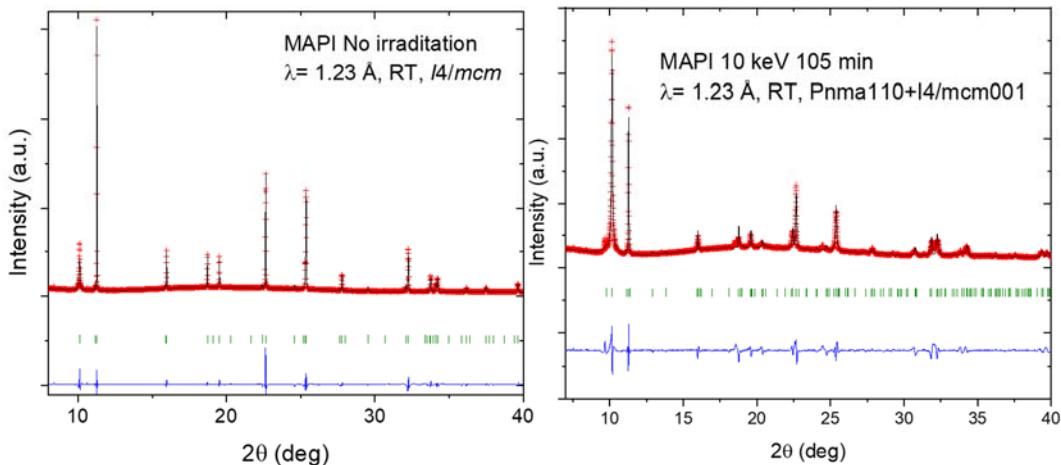


**Figure S2.** Calculated diffraction patterns for PbI<sub>2</sub> a) powder/polycrystalline and b) fully (001) textured film; c) measured patterns for a pristine and 6300 s x-ray irradiated MAPbI<sub>3</sub> film, vertical red lines indicate the positions of PbI<sub>2</sub> peaks with the assignment to specific reflections and their relative intensities for power sample. The inset shows zoomed regions relevant for PbI<sub>2</sub> revealing the almost complete (001) orientation for the most degraded case.

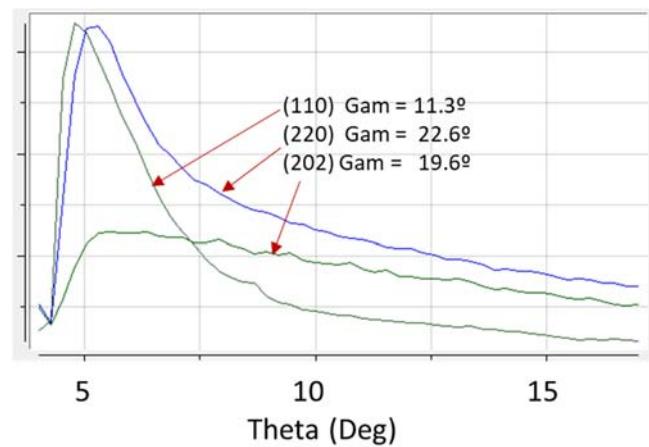
a)



b)



**Figure S3. a)** Different fits of the most degraded film (6300 s x-ray irradiated film) using several approaches: tetragonal  $I4/mcm$  phase (dark green),  $Pnma$  phase, two tetragonal phases with two preferential orientations and different lattice parameters,  $I4/mcm + Pnma$  (red). **b)** Best fits for the non-irradiated sample (left) and the most damaged one (right) .



**Figure S4.** Rocking curves for different reflection peaks of MAPbI<sub>3</sub>:Bi film.