Poster

Electron beam induced degradation of $MAPbI_3$ revealed by low dose 3DED

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The prototypical methylammonium lead iodide ($MAPbI_3$) belongs to the class of hybrid organic-inorganic perovskites (HOIP), and has been a material of intensive scientific interest due to the technological relevance in fabricating state-of-the-art solar cells (cite). Much of the structural characterization of $MAPbI_3$ to date are carried out based on diffraction and electron microscopy techniques, but the highly delicate nature of the hybrid material makes precise characterization utilizing high energy electron microscopy difficult. Earlier Scanning Transmission Electron Microscopy (STEM) studies highlighted that a dose of around 300 e$Å^2$ would induce a superstructure phase transition [1], and that low temperature cryogenic conditions would help to preserve the material for imaging [2]. However, these studies are limited by the high dose required in STEM and HRTEM mode, and the resulting images which are 2 dimensional (2D) projections of the 3D material. Similarly, the selected area electron diffraction (SAED) patterns are also limited of one 2D projection plane. In this work utilizing 3D electron diffraction (3DED) at room and low temperatures, we show that using doses at steps of 5 e$Å^2$, which is an order of magnitude lower than that in STEM studies, the nanosized $MAPbI_3$ perovskite crystals undergoes a degradation through a phase transition while concurrently losing crystallinity showing the delicateness of this class of hybrid material.

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[2] Y. Li, W. Zhou, Y. Li, W. Huang, Z. Zhang, G. Chen, H. Wang, G.-H. Wu, N. Rolston, R. Vila, W. Chiu, Y. Cui, (2019) *Joule*, **3**, 2854