

# In-Situ Grating Incidence Wide Angle X-Ray Scattering for Hybrid Perovskite Semiconductors

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Hybrid perovskite materials recently emerge as the next generation semiconductors, where the superior opto-electronic properties have enabled unprecedented surge in the field of electronic devices. Those properties are tied closely the hybrid structure, for instance, local bright states were observed due to structural distortion; surface states can trap exciton that leads to broad band emission. Here in my talk, I will introduce the importance of in-situ structural characterization in the perovskite based semiconducting devices under various operational conditions. We have observed lattice change and deformation triggered by optical signals. By monitoring the Grating Incidence Wide Angle X-Ray Scattering (GIWAXS) map in-situ during the perovskite photovoltaic device operational conditions, we observed a systematic lattice expansion along all stacking axis. Such expansion releases the local strain in the film that greatly improved the photovoltaic performance. Furthermore, we measured the lattice change under ultra-fast laser beam and discovered the dynamic motion of the perovskite lattice that tend to expand and relax in tens of nanosecond time scale. Such process scales nicely with the laser power and follows the photoluminescence decay time, that truly demonstrates photo-generated charges are the origin for the structure change.

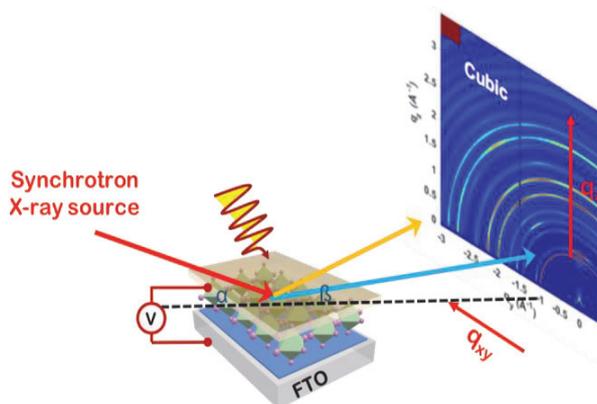


Fig. 1 In-situ GIWAXS setup to characterize the device