Diffractive Imaging of Mesostructure in Disordered Energy Materials

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Materials for energy applications, such as in batteries and fuel cells, are by nature out of equilibrium during operation. Defects and changes in the material morphology dynamically evolve and affect kinetics and reversibility of function. The changes in the crystal lattice must then be detected operando or in-situ to understand underlying physical processes. Imaging methods have demonstrated that transient dislocations briefly appear in intercalation hosts during ion diffusion in various environments. Here, we summarize several of our findings obtained by operando Bragg Coherent Diffractive Imaging (BCDI) in energy materials, demonstrating how BCDI captures stages of formation of metastable defects, cracking, and layer delamination in various perovskite materials for battery cathodes and fuel cell proton conductors.