

Phase Domains in Solid-State Electrolyte Crystals

Early BCDI science workshop of the CDI Beamline

Ian K. Robinson^{1,2}

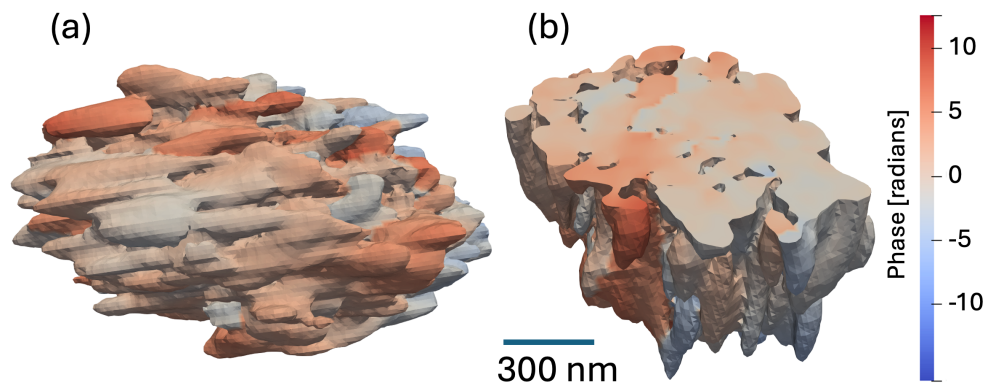
¹*Condensed Matter Physics and Materials Science, BNL, Upton NY 11973*

²*London Centre for Nanotechnology, University College, London WC1E 6BT*

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Author Email: irobinson@bnl.gov

I will present results recently obtained by Bragg Coherent Diffraction Imaging (BCDI) on solid-state electrolyte (SSE) materials. BCDI is highly sensitive to phase shifts within crystalline materials, allowing access to phase domains within materials that are virtually invisible to other techniques. There is a well-documented strong enhancement in conductivity [1] for high-entropy formulations of SSE materials. This is considered to be a “High Entropy” effect because the configurational entropy contributes a significant change to the free energy at room temperature. In our experiments, we find that NASICON family SSEs have a distinct pattern of phase domains, 50-100 nm in size, with sharp domain walls between them, shown in the figure [2]. It is possible that these domain walls can contribute to the ion conduction mechanism and that this is a plausible mechanism. Our breakthrough was the realization that these domains may be introduced by the mechanical ball-milling step used to prepare the SSE samples. It is known that in other battery-relevant materials, high-energy ball milling, intended to reduce the grain size, can also enhance the ion conductivity [3].



References

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- [3] Effect of Ball Milling on the Atomic Configuration of $\text{Li}_{1.3}\text{Nb}_{0.3}\text{Fe}_{0.4}\text{O}_2$ with a Disordered Rocksalt Structure, Naoto Kitamura, Yuna Hayashi, Chihaya Hasegawa, Chiaki Ishibashi, and Yasushi Idemoto, *J. Japan Society of Powder and Powder Metallurgy* (2025)