**[Measurement of salt concentration and morphology gradients in block copolymer electrolytes using in situ Small-angle X-ray scattering](https://acs.digitellinc.com/acs/live/22/page/677/6?eventSearchInput=&eventSearchDateTimeStart=&eventSearchDateTimeEnd=&eventSearchTrack%5b%5d=201" \l "sessionCollapse394116)**

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Solid block copolymer electrolytes with lithium salt are promising materials which could enable practical batteries with highly energy-dense lithium metal anodes. These materials phase separate into ion-conductive domains, enabling ion transport, and mechanically-rigid domains, which enhance safety. The morphology, size, and orientation of these domains can significantly impact the performance of the electrolyte, and can depend on both time and position as a gradient in salt concentration develops during application of an electric potential.

We have established a setup to obtain highly spatially- and temporally-resolved small-angle x-ray scattering (SAXS) data during *in situ* cycling of an electrochemical cell with lithium electrodes. We recently performed these experiments on an asymmetric polystyrene-*b*-poly(ethylene oxide) (SEO) electrolyte with a poly(ethylene oxide) (PEO) molecular weight of 22,400 g/mol and a polystyrene molecular weight of 4,000 g/mol, which phase separates into a majority-PEO morphology with spheres and/or cylinders—depending on salt concentration—of polystyrene. In these experiments, we have implemented equipment modifications which allow us to use x-ray transmission to directly measure salt concentration. This marks the first direct measurement of salt concentration gradients *in situ* in these systems, which allows us to validate theoretical predictions and better explain morphological and electrochemical behavior. Our scattering data indicates both asymmetry in domain expansion and contraction and changes between spheres and cylinders of polystyrene due to the strain of non-equilibrium changing salt concentrations; quantifying this strain allows us to gain new information about the behavior of block copolymer electrolytes in action and the mechanisms of their failure. This informs the systematic design of the next generation of solid electrolyte materials.

