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Phase separation predicted to induce water-rich channels in fuel cell membranes[1] DANIEL HERBST, THOMAS WITTEN, University of Chicago, TSUNG-HAN TSAI, University of Illinois at Urbana-Champaign, BRYAN COUGHLIN, University of Massachusetts Amherst, ASHLEY MAES, ANDREW HERRING, Colorado School of Mines — Fuel cells are a promising alternative energy technology that convert chemical fuel directly into electric power. One important fundamental property is exactly how and where water is absorbed in the polyelectrolyte membrane. Previous theoretical studies have used idealized parameters. In this talk, I show how we made a rigorous connection to experiment to make parameter-free predictions of the water-swelling behavior, using self-consistent field theory. The model block co-polymers we studied form alternating hydrophilic/hydrophobic lamellar domains that absorb water in humid air. I will show how simple measurements of the hydrophilic portion in solution lead to predictions of non-uniform water distribution in the membrane, and compare the results to x-ray scattering. The results suggest locally near-uniform water distributions. In special cases, however, each hydrophilic lamella phase-separates, forming an additional water-rich lamella down the center, a beneficial arrangement for ion conductivity. A small amount of water enhances conductivity most when it is partitioned into such channels, improving fuel-cell performance.

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