Title: Block copolymer electrolytes with everything in its right place

Abstract:
Polymer electrolytes are ubiquitous to numerous electrochemical processes that store and convert energy, synthesize chemicals, and purify water. An important priority for these materials is maximizing their ionic conductivity, a key transport property, without compromising their mechanical integrity. Block copolymer electrolytes (BCEs) are attractive subset of polymer electrolytes because their microphase-separated architecture concentrates the ionic domains for rapid ion transport while the other domain independently provides mechanical strength. However, there is a poor understanding between microstructure of BCEs and bulk properties like ion transport.

In this talk, the process of directed self-assembly will be presented for controlling the microphase separated structure in BCEs with astonishing fidelity. Key results highlight that ionic conductivity of BCEs followed an exponential growth curve with respect to ionic domain connectivity. Conversely, small amounts of terminal defects of the ionic domains rendered no advantage in ionic conductivity for microphase separated systems over non-phase separated systems. Ionic domain alignment to electrode surfaces with a tortuosity of 1 yielded a 4 order of magnitude improvement in ionic conduction over anti-aligned ionic domains. The results have far reaching implication for the rationale design of BCEs and highlight that unlocking the potential of these materials necessitates ‘perfect’, long-range ordered structures. The talk will concluded with our current efforts to make structured electrochemical interfaces for fuel cell and water electrolysis devices using conventional micropatterning and advanced block copolymer lithography.

Biography:
Chris Arges is the Gordon A. and Mary Cain Professor in Chemical Engineering at Louisiana State University. Chris attended the University of Illinois at Urbana-Champaign and earned a B.S. in Chemical Engineering. Afterwards, he spent four years as a product development engineer in the pharmaceutical industry at Hospira and Baxter. While working fulltime, he completed his M.S. in Chemical Engineering at North Carolina State University. He then went on to earn a Ph.D. in Chemical Engineering at the Illinois Institute of Technology followed by a postdoctoral joint appointment at the University of Chicago and Argonne National Laboratory in the Institute for Molecular Engineering.