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Quantifying Ion Transport in Polymers Using Electrochemical Quartz Crystal Microbalance with Dissipation JODIE LUTKENHAUS, SHAOYANG WANG, Texas AM University — For polymers in energy systems, one of the most common means of quantifying ion transport is that of electrochemical impedance spectroscopy, in which an alternating electric field is applied and the resultant impedance response is recorded. While useful, this approach misses subtle details in transient film swelling, effects of hydration or solvent shells around the transporting ion, and changes in mechanical properties of the polymer. Here we present electrochemical quartz crystal microbalance with dissipation (EQCMD) monitoring as a means to quantify ion transport, dynamic swelling, and mechanical properties of polymers during electrochemical interrogation. We focus upon EQCMD characterization of the redox-active nitroxide radical polymer, poly(2,2,6,6-tetramethylpiperidinyloxy methacrylate) (PTMA). Upon oxidation, PTMA becomes positively charged, which requires the transport of a complementary anion into the polymer for electroneutrality. By EQCMD, we quantify anion transport and resultant swelling upon oxidation, as well as decoupling of contributions attributed to the ion and the solvent. We explore the effect of different lithium electrolyte salts in which each salt gives different charge storage and mass transport behavior. This is attributed to varied polymer-dopant and dopant-solvent interactions. The work was supported by the grant DE-SC0014006 funded by the U.S. Department of Energy, Office of Science.

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