DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Department of Materials Science and Engineering,

PhD Candidacy Exam

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Impact of Ion Coordination and Chain Segmental Motion on Transport Dynamics in Solid Polymer Electrolytes

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Abstract:

Solid polymer electrolytes (SPEs) provide a promising alternative to liquid electrolytes for use in lithium metal batteries due to their improved dendrite resistance, enhanced fire retardance, high flexibility and excellent processability. One of the greatest hurdles for practical application of SPEs is its low associated ionic conductivty. This drawback inhibits fast charging and also leads to greater internal resistance across the battery cell which decreases its overall capacity. Thus, it becomes instrumental to deepen our understanding of the mechanisms underlying ionic conduction in SPEs in order to design membranes with enhanced transport properties. To better understand ion migration in SPEs, the factors governing ion solvation and coordination must first be made clear. The influence of factors such as dielectric constant and monomer strucutre on ion solvation strength and its resulting coordination strucutre will be discussed. Next, ion transport will be explained in terms of free volume theory and the associated Vogel-Fulcher-Tamman (VFT) temperature dependance it follows. Means of improving free volume and thus ion transport through manipulation of molecular architecture will then be covered. To better understand the influence of monomer strucutre on ion dynamics, how ion coordination strength correlates to its transport mechanism will also be illustrated.