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DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING
COLLEGE OF EARTH AND MINERAL SCIENCES

~~~~ Polymer Physics Seminar ~~~~

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10:00 AM Tuesday

February 2th, 2010

301 Steidle Bldg.

Counterion Dynamics in Polyurethane-Carboxylate Ionomers with Ionic Liquid Counterions

Single-ion conductors have potential utility for electronic devices like battery membranes, actuators and other applications. For such applications, both high ionic conductivities and high modulus are desirable. To achieve these two goals, polyurethane ionomers can be suitable candidates: the hydrogen bonded hard phase provides good modulus while the soft phase (PEO in our system) can still facilitate ion transport. Polyurethane carboxylate ionomers based on PEG 600 with sodium, ammonium, phosphonium and imidazolium cations are synthesized for systematic comparison of different cationic counterions. Both the size and species of cations impact the soft segment T_g. Generally, larger cations result in lower T_g due to weaker Columbic force (acting as physical crosslink) between ions and acting as a plasticizer. Soft segment T_g can be reduced from 50°C to -10°C when replacing Na^+ with large ether-oxygen containing ammonium without changing polymer composition and the lower T_g can enhance ionic conductivity by 5 orders of magnitude. Ionic conductivity has a stronger correlation with segmental relaxation than with T_g, suggesting that counterion motion is coupled to the segmental motion of poly(ethylene oxide) in the soft phase. An electrode polarization model was used to quantify the conducting ion concentration and mobility. As expected, the conducting ion concentration has an Arrhenius temperature dependence and the mobility is proportional to the alpha-relaxation frequency of the soft segment.