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

~~~~ Polymer Physics Seminar ~~~~

Jing-Han Helen Wang

Chemical Engineering, Penn State University

Advisor: Professor Ralph H. Colby

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301 Steidle Bldg.

Structure-Dynamics Relationship of Poly(ethylene oxide)-Based Single-Ion Conductors

To optimize the design of ion-containing polymers for advanced devices, the effects of different structural factors on the electrical properties of single-ion conductors (ionomers) needs to be investigated. By the design of ionomer systems and systematically varying the chemical structure, the effects of ion content, side chain flexibility, and free and attached ion solvation by ether oxygen atoms can be investigated. Dielectric relaxation spectroscopy is used to measure the conductivity, dielectric constant and segmental relaxations in these ionomers and the electrode polarization at very low frequencies is used to assess the number density of simultaneously conducting ions and their mobility.

In the comparison of a polycation system to a polyanion system with the counterions being analogs of the ions attached on the polymer, ether oxygen atoms solvate the free cations better than the attached cations. As the ion content of an ionomer increases, the conducting ion concentration and static dielectric constant is expected to increase until a limit is reached where the ion-ion and ion-dipole interactions restrict ionic mobility, and conducting ion concentration drop significantly. When shorter PEO side chains are used, the flexibility of the polymer is restricted by the stiff polymer backbone, and the ion-dissociating ability of PEO is weakened that leads to more ionic aggregates. Changing ester linkages to amide linkages in polycations boosts conductivity and conducting ion content by solvating the anionic counterion.