~~~~ Polymer Physics Seminar ~~~~

Jiezhu Jin

Materials Science and Engineering, Penn State University

Advisor: Professor Qing Wang and Aman Haque

10:00 AM Tuesday August 30th, 2011

301 Steidle Bldg.

Multiferroic Polymer Composites

The co-existence of ferroelectricity and ferromagnetism in multiferroic materials opens up a host of new collective properties. In particular, the magnetoelectric (ME) effect – the induction of electric polarization by a magnetic field or of magnetization by an electric field – has been studied the most in multiferroics. It has been found that larger (up to several orders) ME coefficients can be harvested from strain-mediated indirect ME laminate composites of piezoelectric and magnetostrictive components than single-phase multiferroics. Compared to traditional ceramic composites, the polymer composites offer inherent advantages including easy processing, mechanical flexibility and ability to be molded into intricate configurations for advanced devices with reduced volume and weight. Additionally, the polymer composites generally exhibit superior ME coefficients, attributable to great displacement transfer capability of the flexible polymer matrix. Herein I will present our research on the ME multiferroic laminate composite based on Metglas (magnetostrictive material) and new classes of piezoelectric polymer films: (i) chain-end cross-linked poly(vinylidene fluoride-*co*-trifluoroethylene) (PVDF-TrFE) and (ii) uniaxially stretched hydrated poly(vinylidene fluoride-*co*-hexafluoropropylene) P(VDF-HFP). The resulting composites exhibit the ME coefficients as high as 17.70 V/cm Oe and 21.98 V/cm Oe, respectively, which place them among the best multiferroic materials reported to date. This presentation covers the synthetic strategy, film processing and characterization methods of the ME polymer composites. This work fully explores the role of hydrogen bonding in promoting the formation of high crystallinity, large crystalline size, and improved polarization ordering, which result in a greatly enhanced piezoelectric effect of ferroelectric polymers and in turn very large ME coefficients. It is expected that by combining the versatile structures of electroactive polymers and great flexibility in molecular design and modification, the performance of the multiferroic composites can be further enhanced.