



DR. EUGENE FURMAN

Materials Research Institute, Pennsylvania State University

MODELS OF DIELECTRIC BREAKDOWN IN CAPACITORS

There is considerable interest in developing capacitors with increased energy density approaching 30 J/cm³ which is more than an order of magnitude greater than for the majority of commercial capacitors. Of crucial importance to increase energy density is improved understanding of factors controlling dielectric breakdown strength and Weibull modulus for different families of materials. In this presentation I will describe Monte Carlo modeling of dielectric breakdown for ferroelectric ceramics, semicrystalline polymers, and layered composites. The modeling results indicate that structural and chemical heterogeneities have a considerable influence on dielectric breakdown strength ranging from highly beneficial, such as observed in biaxially stretched polypropylene and layered dielectrics, to exceedingly detrimental such as porosity in ferroelectric ceramics. Interestingly, percolating pathways play important role for both positive and negative contributors to the breakdown strength and they also impact characteristics of Weibull modulus. The advantage of Monte Carlo modeling is that it reveals probabilistic nature of breakdown and enables direct comparisons of breakdown statistics between experiments and models. Modeling of the layered dielectric composites, in agreement with experiments, revealed extended lifetime of dielectrics compared to homogeneous dielectrics. A large dielectric contrast between the composites' phases contributes to the dielectric reliability by extending the breakdown tree laterally within the high dielectric constant layer. Challenges and opportunities facing materials with large electrocaloric effect for dielectric energy storage applications will also be explored in this presentation.

Host:
Stephen Ducharme

**Friday, 22 May 2009
201 Brace Lab
1:30 p.m.**