

IOWA STATE UNIVERSITY

Materials Science & Engineering Department

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Final Oral Examination  
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*Tuesday, July 15 · 10:00AM · 1322 Hoover*

## “Dielectric Characterization of High-Performance Spaceflight Materials”

As commercial space travel increases, the need for reliable structural health monitoring to predict possible weaknesses or failures of structural materials also increases. Monitoring of polymer-based materials may be achieved through the use of dielectric spectroscopy by comparing permittivity or conductivity measurements performed on a sample in use to that of a pristine sample. Changes in these measured values or of the relaxation frequencies, if present, can indicate chemical or physical changes occurring within the material and the possible need for maintenance/replacement. In this work, we established indicative trends that occur in dielectric spectra during accelerated aging of various high performance polymeric materials (EVOH, PEEK, PPS, and UHMWPE). Uses for these materials range from electrical insulation and protective coatings to windows and air- or space-craft parts that may be subject to environmental damage over long-term operation. Accelerated thermal aging and ultraviolet/water-spray cyclic aging were performed in order to investigate the degradation of the aforementioned material. The Havriliak-Negami model was used in the analysis of the measured dielectric spectra in order to obtain the characteristic fit parameters from which aging-related trends were identified. With reference to the literature and from measured FTIR spectra, observations were connected to the underlying mechanisms causing the dielectric relaxations.