UCI Samueli School of Engineering

Department of Materials Science and Engineering UCI

# UNIVERSITY OF CALIFORNIA, IRVINE

## DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

## IS PROUD TO HOST A SEMINAR BY

***"THE INTERPHASE IN NANOSTRUCTURED POLYMERS: COUPLED EXPERIMENT-COMPUTATIONAL APPROACH AND MACHINE LEARNING FOR INTERPHASE DESIGN"***

# L. CATE BRINSON

**PROFESSOR AND CHAIR**
**DEPARTMENT OF MECHANICAL ENGINEERING AND MATERIALS SCIENCE**
**DUKE UNIVERSITY**

**Thursday, May 1, 2025**

**2:00 PM - 3:20 PM**

**McDonnell Douglas Engineering Auditorium**

**Abstract:** For polymer composites, nanocomposites and polymer thin film systems, the local properties of polymers can be altered by the chemical and physical interactions with substrates and embedded particles over length scales exceeding 100nm. The mechanisms and impact of confined polymers remains still an active area of research and debate. Here we present a scanning probe method to quantitatively explore nanoscale polymer properties near surfaces, including a novel computational mechanics approach to analyze the data. Coupling experimental data with simulations of indentations enable the structural effects of the particle-polymer-tip system to be accurately estimated and removed, revealing the effects of confinement on property gradients. Capturing and archiving this data allows case studies which connect the property-structure-property domains through a combination of machine learning and physics-based modeling. We demonstrate the ability to identify the most critical features that influence properties and the ability to acquire new insights from ensembles of unrelated data. The importance of data, data resources and leverage of this knowledge in new physics based and interpretable machine learning methods is discussed. A new surrogate model, ViscoNet, for nanocomposite design is presented. Overall this work illustrates new approaches combining physics and data based models and experiments to tackle materials design principles for the complex, high dimensional problems inherent in the multi-phase polymer space.

**Bio:** L. Cate Brinson is the Sharon C and Harold L Yoh III Professor of Engineering and the Donald M Alstadt Department Chair of the Mechanical Engineering and Materials Science Department at Duke University. She received her BS from Virginia Tech, PhD from Caltech, did a postdoc at the DLR in Germany and began her academic career at Northwestern University in 1992, serving in many roles, including as Department Chair for Mechanical Engineering and an Associate Dean in the McCormick School of Engineering. She is an expert in the broad area of mechanics of materials, with emphasis on complex hierarchical materials and polymer based systems, and merging concepts of data science into materials. Experimental and computational work spans the range of molecular interactions, micromechanics and macroscale behavior. Current research foci include nanostructured polymers, interfacial behavior, structural metamaterials and data platforms for material query and design. Dr. Brinson has received a number of awards, including the Eringen Medal of SES, the Nadai Medal of the ASME, the Friedrich Wilhelm Bessel Prize of the Alexander von Humboldt Foundation, and is Fellow of many professional societies including the American Associate for Advancement of Science, AAAS. She has authored one book and over 200 refereed journal publications with over 32000 citations and an h-index of 76 in Google Scholar. Her book Polymer Engineering Science and Viscoelasticity has had over 130,000 chapter downloads from the e-version since publication. She served 5 years on the Society of Engineering Science Board of Directors, one year as President, and is a founding member of the Materials Research Data Alliance (MaRDA).