UNH Materials Science Seminar

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DeMeritt Hall 240
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Exploring Microstructure Development in Coatings with Cryo-SEM

Prof. Lorraine F. Francis

Department of Chemical Engineering and Materials Science,
University of Minnesota

A wide variety of products, including photographic film, adhesives, membranes, fuel cell components, newsprint and labels, are produced by coating processes. These processes occur in two main steps: deposition of a liquid (e.g., solution, dispersion) onto a substrate and solidification of the liquid layer, typically by drying or curing, into a functional coating. The final microstructure and properties of the coating depend critically on the solidification step. For coatings solidified by drying, capturing the microstructure development is challenging because wet coatings cannot be imaged by the standard scanning electron microscopy (SEM), which requires high vacuum. Cryogenic SEM (cryo-SEM), however, is an ideal tool for capturing the stages of microstructure development during drying. The method was originally developed for the study of water-laden biological specimens, but is now being applied to materials science problems. This talk will feature the use of cryo-SEM to uncover the microstructure in coatings prepared from particulate dispersions, including polymer latex and ceramic particles. Cryo-SEM images of the dispersions before coating reveal particle-particle interactions as well as unusual structures that may only exist in the suspended state. During drying, the distribution of particles depends on drying conditions and the characteristics of the particles. In the early stages of drying, the distribution can be understood in terms of competing effects of diffusion, evaporation and sedimentation. Later, capillary effects enter in. The microstructure development in coatings containing two different types of particles is especially interesting because conditions may lead to nonuniformity in the particle distribution through the thickness.

Dr. Francis is currently a professor and L.E. Scriven Chair of Chemical Engineering and Materials Science at University of Minnesota. She is also the Director of Undergraduate Studies in Materials Science and Engineering. She received a Ph.D. in Ceramic Engineering from University of Illinois at Urbana-Champaign in 1990. Her current research areas include coatings, materials processing, and ceramic-polymer composites.

Host: Prof. John Tsavalas, ×2293