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Department of Mechanical Engineering
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“Viscoelastic Characterization of Polymers Using Nanoindentation”

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Abstract

Instrumented indentation, sometimes referred to as nanoindentation, is increasingly being used to probe the mechanical response of polymeric materials. In contrast to traditional engineering materials (i.e., metals and ceramics) to which indentation techniques have most often been applied, the characterization of polymers by a single modulus or hardness values is often of limited value because of their viscoelastic nature. Additionally, polymers often behave in a nonlinear fashion at relatively small levels of strain, and their responses to tension, compression, or shear can be quite different. Thus, a number of challenges exist to applying instrumented indentation methods to polymeric materials. In this research, instrumented indentation is used to characterize the time-dependent responses of both glassy and rubbery polymers at room temperature using a variety of tip geometries. Results from a variety of testing methods will be presented, including energy absorption as a function of loading rate, indentation creep and indentation stress relaxation tests, and dynamic mechanical indentation measurements. Various methods of analysis will be discussed, and comparisons will be made between indentation data and data from traditional solid rheology measurements.

About the Speaker

Dr. Mark VanLandingham joined the U.S. Army Research Laboratory (ARL) in 2003 and is currently the Chief of the Multifunctional Materials Branch. Prior to joining ARL, Dr. VanLandingham spent 5 years at the National Institute of Standards and Technology (NIST), initially as a National Research Council Postdoctoral Research Associate and later as a Materials Research Engineer. He holds a Ph.D. degree in Materials Science and Engineering (1998) from the University of Delaware, a M.S. degree in Materials Science and Engineering (1993) from the University of Illinois, and a B.S. degree in Engineering Science and Mechanics (1991) from Virginia Tech. Dr. VanLandingham is an expert in polymers, viscoelasticity, contact mechanics, instrumented indentation, and atomic force microscopy, and he has over 30 peer-reviewed publications and 1 patent.

