



College of Engineering
Department of
Mechanical & Industrial Engineering

The Sidney E. Fuchs Seminar Series

3:00-3:50pm, Friday, November 6th, 2015
Frank H. Walk Design Presentation Room



Expanding the Use of Frequency Specific Techniques during Nanomechanical Testing

by **Warren Oliver***

**President,
Nanomechanics, Inc.**

Since its invention in 1992 (US patent No: US4848141 A) frequency specific indentation testing has become a powerful tool for researchers to characterize materials and structures at small scales. The fact that the stiffness of a contact between two materials is much easier to measure at small contact dimensions became obvious near the first implementation of nanoindentation testing. Models were developed to use these measurements to understand the elastic response of materials soon after the first measurements. The low values of stiffness exhibited by extremely fine scale structures are also often easier to measure accurately than their macroscopic counterparts. In this talk we will review the use of frequency specific mechanical excitation to measure the stiffness of a contact or structure. To accurately perform these experiments over a wide range of the important experimental parameters (frequency, time, temperature, load, displacement and stiffness) the experimental equipment must be carefully designed in such a way that the base line dynamic response is as simple as possible. The accuracy of the model used to describe the apparatus determines the smallest and largest values that can be measured from the sample.

Indentation testing with sharp, pyramid shaped indenters are now done over an extremely wide range of depth, load, and stiffness. They are still one of the most common and challenging type of experiment to perform. The stiffness of the contact changes many orders of magnitude during the indentation process. The newest testing and analysis techniques for these experiments will be discussed. The time required to perform these tests has been reduced several orders of magnitude. The increased speed with which the experiments can be performed has opened the door to new applications for these experiments. These include mapping properties in both two and three physical sample dimensions and high temperature testing.

* Warren Oliver obtained his B.S. in Materials Science from the University of Tennessee in 1976. He received a MS and PhD of Materials Science in 1981 from Stanford University, studying with Professor W. D. Nix. Dr. Oliver spent one year on a postdoctoral appointment at Brown, Boveri and Co., Ltd followed by two years (1982-1984) at the United Technologies Research Center. He then returned to Tennessee for a position at Oak Ridge National Laboratories for ten years until 1994, at which time he left to spend full time directing Nano Instruments, a company he helped to found in 1984. In 1998 Nano Instruments was acquired by MTS Corporation. In 2008, the group was acquired by Agilent Technologies. In 2009, Dr. Oliver helped form and became president of a new company, Nanomechanics, Inc.