Carnegie Mellon
Materials Science and Engineering Seminar Series

Michael D. Uchic

Materials and Manufacturing Directorate
Wright-Patterson Air Force Base

"Measurement of mechanical properties at the micro-scale"

Friday, February 26, 2010
11:30 A.M. Seminar in Scaife Hall 125

Over the past seven years, the author and co-workers have developed and refined test methodologies that have been used to characterize the mechanical properties of metals and alloys at the micron-size scale. These characterization methodologies rely on focused ion beam milling to prepare miniature mechanical test specimens from bulk samples. The small samples are subsequently tested using either a conventional nanoindentation device outfitted with a flat-punch tip (uniaxial compression), or a custom in-situ test system that operates inside a SEM (compressive and tensile modes). This talk will present selected applications of these methodologies to explore the properties of FCC metals and derivative alloys, in order to demonstrate the effect that reducing sample dimensions to the micro-scale have on the fundamental micro-mechanisms of dislocation-based deformation processes. This talk will also highlight the effect that the constraints imposed by the test device can have on the resultant mechanical response of microcrystals that are oriented for single slip deformation. Lastly, this talk will show some recent efforts to characterize both the mechanical properties as well as the internal microstructure of miniature single crystal and polycrystalline Ni superalloy samples.

Dr. Michael D. Uchic graduated from Stanford University with a Ph.D. in Materials Science and Engineering, and for his thesis he characterized the low-temperature mechanical properties of the intermetallic alloy Ni_3Al. Dr. Uchic joined the Metals Development Group of the Materials & Manufacturing Directorate in 1998, and initially worked on the development of nanocrystalline aluminum alloys and the direct vapor synthesis of high temperature alloys. In 2001, he changed research focus with the start of Accelerated Insertion of Materials program, and for the past eight years his research efforts have focused on the development of new experimental methods to rapidly assess both the microstructure and mechanical properties of aerospace metals. In 2004 he was recognized for his research efforts in micro-mechanical testing with the AFRL/ML Charles J. Cleary Award for Scientific Achievement.