



Making Nanodevices Stronger

Wednesday April 11, 2012 - Babbio 122, 11am

Dr. Brad L. Boyce

Materials Science and Engineering Center

Sandia National Laboratories, Albuquerque, NM

The blooming field of nanotechnology is providing pathways towards exceptionally strong, durable materials. Materials that are weak at the macroscale can become strong when fabricated at the micro- or nanoscale. In this talk, we will look at two areas of research where exceptional mechanical performance can be found at small length scales. In the first example, we will look at the strength of silicon-based microelectromechanical systems (MEMS). Recent advances in test capabilities for MEMS devices now permit 1000's of tensile tests to be performed in a matter of hours. The resulting statistical analysis gives insight into new design paradigms for highly reliable microsystems. The results also highlight the key role that processing and microstructure play in controlling the failure-critical flaws. In the second example, we will look at the fatigue performance of nanocrystalline Ni-based alloys. These alloys exhibit exceptional fatigue performance well beyond conventional commercially-available alloys. Further, due to their nano-scale grain size, the traditional cyclic damage mechanism (so-called persistent slip) for fatigue crack initiation is suppressed until the microstructure undergoes fatigue-induced grain growth. Only when the grains have been mechanically coarsened to sizes well above the nanoscale, do the traditional fatigue processes lead to failure. The result is an alloy which can survive many orders of magnitude longer fatigue lives before failure compared to conventional alloys.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Brad L. Boyce received the B.S. degree in metallurgical engineering from Michigan Technological University in 1996, and the M.S. and Ph.D. degrees in materials science and engineering from the University of California at Berkeley in 1998 and 2001, respectively. Dr. Boyce is a Principal Member of the Technical Staff at Sandia National Laboratories in Albuquerque, New Mexico. His primary research interests are in mechanical performance and reliability of structural materials and MEMS materials. Dr. Boyce is a Key Reader for Metallurgical Transactions, and a former Hertz Fellow.

