

Purdue University

School of Materials Engineering

Presents

Date: Friday,

Sept. 27, 2013

Time: 3:30 Refreshments

3:45 Seminar

Place: ARMS 1010



**Infinite
Possibilities**

Professor T. John Balk

University of Kentucky

Department of Chemical Materials Engineering

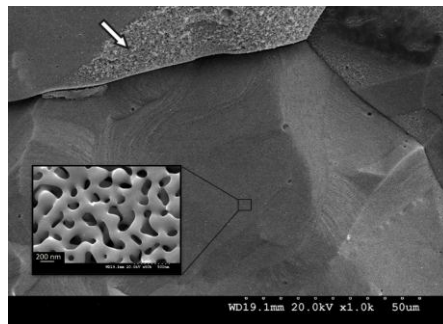
Lexington, KY



ABSTRACT

Mechanical Properties and Scaling Behavior of Dealloyed Nanoporous Materials

Nanoporous materials exhibit unique mechanical behavior, combining size effects due to limited deformation volume in the ligaments and scaling effects due to the porous structure. Nanoporous noble metals including gold (np-Au) and iridium (np-Ir) can be produced from AuAg and IrNi precursor alloys by dealloying, in both bulk form and as thin films. These materials exhibit fine ligaments (3-10 nm for np-Ir and 15-50 nm for np-Au) and high purity (>90 at.% of the sacrificial element removed in each case). The mechanical behavior of bulk np-Au was investigated by millimeter-scale tension and compression testing, and by nanoindentation. The correlation of tensile/compressive strength with nanoindentation hardness will be presented. Results from thin film np-Ir thermomechanical testing will also be presented, along with a new processing route that allows partial control of ligament orientation and spacing. Elastic modulus, strength and fracture behavior of each np material will be discussed and compared with that of its corresponding dense form, and will be interpreted in light of scaling equations for nanoporous material mechanical behavior, which differs from that of traditional porous materials.



SHORT BIO

John Balk is an associate professor in the Department of Chemical and Materials Engineering at the University of Kentucky, where he has worked since August 2004. He received his BS degree from the University of California, Berkeley, where he double-majored in mechanical engineering and materials science and engineering. He received his PhD and MS degrees in materials science and engineering from The Johns Hopkins University. Before coming to UK, he was a staff scientist at the Max Planck Institute for Metals Research in Stuttgart, Germany, where he also completed his post-doctoral work. His research focuses on structure-property relationships in the mechanical behavior of metals, alloys and covalent materials, primarily systems that allow the study of size effects. Currently he is working to understand the deformation mechanisms that operate in nanoporous materials, and separately, the effects of thin film microstructure on work function of dispenser cathode materials. He is faculty advisor to the Material Advantage student chapter at UK. In 2007, he was awarded the Bradley Stoughton Award for Young Teachers from ASM International, and in 2008 he received an NSF CAREER Award. He served as chair of the 2012 Gordon Research Conference on Thin Film and Small-Scale Mechanical Behavior.