

PENNSTATE



CISP

Center for Innovative Sintered Products

2011 IMM AGENDA / 814-865-2121 / CISP@PSU.EDU / WWW.CISP.PSU.EDU

2011 Industry Member Meeting

Days Inn Penn State
State College, PA
April 13-14



Keynote Speaker



Reginald F. Hamilton

Assistant Professor of Engineering Science and Mechanics, Penn State

THERMO-MECHANICAL HYSTERESIS IN SHAPE MEMORY ALLOYS

Shape memory alloys (SMAs) undergo a diffusionless atomic structure transition known as a martensitic transformation. This reversible phase transformation may be thermal- or stress-induced enabling the recovery of large deformations, up to 12 percent strain, can be fully recovered, albeit a hysteresis exists. Characterizing the hysteresis for classes of SMAs is essential for their practical application for actuation and damping. This talk will provide an overview of different classes of SMAs, which are investigated in order to characterize the material response and understand the underlying physical mechanisms responsible for differential hysteresis magnitudes. Single crystalline alloys are studied utilizing a comprehensive experimental program. The hysteresis was measured in temperature cycling experiments under external stress and also under pseudoleastic deformation conditions. Calorimetry was used to characterize the thermal hysteresis resulting from thermal cycling under zero stress. Differential hysteresis levels arise due to contrasts in the underlying transformation paths. Microscopy and full-field deformation measurements are interpreted in order to expose the transformation path.

Biography:

Dr. Reginald F. Hamilton is an assistant professor of engineering science and mechanics at Penn State. Hamilton received a B.S. degree in mechanical engineering from Southern University-Baton Rouge in 1998. He received his M.S. (2003) and Ph.D. (2008) in mechanical engineering from the University of Illinois at Urbana-Champaign (UIUC), under the direction of Dr. Huseyin Sehitoglu. His research included investigations of conventional NiTi, as well as, high-temperature and magnetic SMAs. The work provided valuable insight into the influence of microstructure and thermo-mechanical treatment on the thermal and stress hysteresis. As a post-doctoral research associate at UIUC from 2008-2009, Hamilton studied adaptive structural transitions in NiFeGa and NiMnGa by measuring meso-scale displacement fields utilizing variable magnification digital image correlation analysis. In 2010, he began his independent career at Penn State. Hamilton's research group characterizes the micro- and macro-scale physical response of conventional, high-temperature, and ferromagnetic SMAs to thermo-mechanical stimuli utilizing advanced deformation measurement techniques and microstructure interrogations. The aim is to elucidate the martensitic phase transformation and physical behavior relationships which facilitate differential levels of transformation hysteresis for smart material systems applications.

Industrial Spotlight



Rocco Petrilli

CEO of 1st Team LLC and representative of Industrial Graphite Sales of Harvard, IL

THE VITAL ROLE OF TOOLING MATERIAL SELECTION AND TOOL DESIGN/MANUFACTURE IN SUCCESSFUL SPARK PLASMA SINTERING FERROUS PRODUCT/PROCESS DEVELOPMENT

Since its recent inception, the vast majority of concentration on spark plasma sintering development has been directed towards the product design and available equipment and capability. Given the advancements in these areas, the technology is rapidly moving to the next level and other important process capability and reliability factors are coming into focus.

This presentation extracts two vital components of this next level, tooling material and tool design and manufacture and addresses the considerations necessary to assure tools role in the launch of

Evening Speaker



Benjamin Legum

Assistant Professor, Clarion University

DETONATED NANODIAMOND POWDERS: THE MAGIC DUST

Detonated nanodiamond powders (DND) have been produced on small scales and characterized over the last 40 years. The advancement of microscopy and spectroscopy techniques over the last 15 years has allowed for the characterization of carbon nanoparticles. Nanodiamonds are a bulk powder material, that when individually looked at, have the same atomic configuration, tetrahedrally bonded carbon crystallized in a cubic diamond lattice structure, as a commonly known macro-scale diamond. To give perspective, the width of a DNA strand is 1.4nm in diameter and the nanodiamonds that are used (NanoBlox Inc.) have an average size distribution of 3-5nm.

Carbon nanoparticulate allotropes have become a novel and exciting field due to the apparent change in properties of normally familiar materials due to size. As an example, in the case of diamonds, what had been thought of as an abrasive, in bulk powder on the nano-scale becomes a lubricant. This talk will provide an overview of current industry sponsored projects for nanodiamonds include sintered coatings, alloys, hardening agents, dendrimers for drug delivery, nanodiamond modified biodegradable and bioinert scaffolds, water purification, heat transfer fluids, and integration into powdered metals for wear resistance and heat transfer.

Biography:

Benjamin Legum is an assistant professor at Clarion University's Center for Applied Research and Intellectual Property Development (CARIPD). Legum earned his B.S. in biomedical engineering and his M.S. in materials engineering from Drexel University, and is ABD for his Ph.D. in materials engineering from Drexel University. His academic background concentrates in the field of nano-scale biological interactions with carbon nanoparticulates, ranging from mechanical and electrical characterization to toxicity. His professional experience includes manufacturing and process engineering for medical devices, and research and development in biomaterials.

Legum's role at Clarion University is to support companies in the northwest region of Pennsylvania to encourage economic development. He provides support for focusing research and scale-up manufacturing processes to get products to market. Currently, he works with NanoBlox Inc. in the discovery and market analysis of nanodiamond products intended for commercial development. He is working with NanoBlox to development scale-up manufacturing, purification, and functionalization techniques while ensuring the highest quality of product. Legum also has ongoing projects with other local companies pertaining to capacitor development and dental implants.

a robust process. Various tool materials, their advantages and the specific contributions of their tooling design, manufacture along with their interaction with the chosen equipment styles will be discussed.

Biography:

Rocco Petrilli is CEO of 1st Team LLC, a professional and technical services firm out of State College, Johnstown and Pittsburgh PA. A 29-year veteran of powder metal and automotive markets, he has amassed significant experience in the areas of process development and product launch and as business executive where he is a veteran of ten business start ups. He has also served as in executive positions with Borg Warner and Federal Mogul and most recently as CEO of PMG/Sinterstahl Corporation where he led the successful green field automotive manufacturing start-up of the company's Pennsylvania location, as well as the acquisition of the company's Ohio and Michigan locations. Petrilli also is founder and CEO of Super Abrasive Machining Innovations LLC of Ridgway, PA.

CISP Industry Member Meeting

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AGENDA

Wednesday, April 13

- 12:30 **Registration / Light Lunch**
- 1:30 **Welcome / Introductions and Status of CISP**—*Donald Heaney*
- 1:40 ESM Highlights—*Judith Todd*
- 1:55 Micro Forming with the Use of Powder Filled Photoresist—*Kevin Geist*
- 2:15 **Keynote Speaker:** Thermo-Mechanical Hysteresis in Shape Memory Alloys—*Reginald Hamilton*
- 3:00 Metal Injection Molding of Refractory Metals—*Don Heaney*
- 3:30 **Break**
- 4:00 Copper-Diamond Composites for Heat-Sink Applications—*Ivi Smid*
- 4:30 The Effect of Vacuum on Final Stage Sintering—*Li Li*
- 4:50 Laser-Sustained Plasma Deposition of Titanium Nitride Nanopowder—*Abdalla Nassar*
- 5:10 **Social**
- 5:30 **Dinner**
- 6:30 Detonated Nanodiamond Powders: The Magic Dust—*Ben Legum*
- 7:15 **Closing / Plan for Tomorrow**—*Donald Heaney*

Thursday, April 14

- 8:30 **Continental Breakfast**
- 9:00 **Welcome**—*Don Heaney*
- 9:05 Financial Update
- 9:10 Materials Testing at CISP—*Michael Disabb-Miller*
- 9:25 Cold Spray Coating on Less Common Materials—*Maryam Neshastehriz*
- 9:45 Encapsulated Aluminum with Nickel—*Michael Callahan*
- 10:05 **Break**
- 10:35 Wear Testing Using the ASTM Standard—*Derek Neupaur*
- 10:50 **Industrial Spotlight:** The Vital Role of Tooling Material Selection and Tool Design/Manufacture in Successful Spark Plasma Sintering Ferrous Product/Process Development—*Rocco Petrilli*
- 11:35 **Lunch**
- 12:30 Industry Council Meeting
- 2:00 **Meeting Adjourned**

