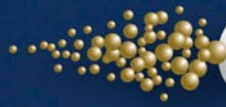




# Center for Innovative Sintered Products



# CISP

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Winter 2005

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## Conference Buzz

Sharon Elder –Executive Director

As we closed out 2004, I took the opportunity to audit our activities and compare with 2003. I found company visits to the CISP lab increased by 50%, training (includes conference, seminars, tutorials) increased 100%, and presentations to CISP personnel given by visiting company representatives increased by 30%. We had visitors from 12 countries in addition to an increase in domestic visitors. We found the majority of company visitors coming with a strong idea for a project and were looking for our collaboration to put them on track as quickly as possible. We continue to find serious interest in areas such as computer modeling, cost modeling, biomedical devices, Ti for automotive applications, and our work on nanopowders.

Over the past year our personnel have attended and participated in 14 conferences. Recognizing that time and travel budgets can be limited, I thought it fitting to share some of the thoughts, observances and highlight topics from a few of the conferences attended.

**XIII International Materials Research Conference**, Cancun, Mexico 22-25 August, attended by Rand German. Mildred Dresselhaus of MIT gave a standing-room only presentation on some of the nanoscale work and its intersection with new computational and electronic tools. Because of her role on national policy boards she showed statistics on worldwide nanoscale activities – amounting to a \$3 billion R&D investment (globally) in 2003. There is some evident opportunity in the hydrogen economy, see report located at [www.sc.doe.gov/bes/hydrogen.pdf](http://www.sc.doe.gov/bes/hydrogen.pdf). One of the goals is to increase hydrogen production twenty-fold in the next 35 years.

Various studies on nanotubes showed tremendous gains and some almost science fiction advances in synthesis, dispersion, alignment, and formation of manufacturing routes. One of the major new efforts is on bismuth nanotubes and some alloys that provide high anisotropic surface energy. Several other excellent talks were given on modeling, liquid flow in nanotubes, new compositions, and ideas for devices to essentially deliver drugs to individual cells.

**International Surface Engineering Congress and Exhibition**, Orlando, FL August 2004, attended by Neal Myers. Attendance was about 200 with good university and foreign attendance. Topics ranged from electroplating, thermal spray, PVD, CVD, tribology, bio-implant applications, industrial gas turbine applications, and diamond films with short programs

*continued inside*

## For Members-Only

Special insert pages...

### • Cost Modeling

*Production costs are becoming ever more important considerations for research projects, even at ...*

### • Effect of Metal Particles on Polymer Burnout Process

*Polymer burnout processing is one of the most critical steps in powder metal processing especially in ...*

### • Two-Phase Master Sintering Curve

*The CISP Modeling and Simulation Group has developed a new two-phase master sintering curve program (2P-MS-CISP) to predict ...*

### • Pressing to Full Density - Capabilities of High Density P/M

*Achieving full density iron based P/M materials in a single compaction operation has long been a topic ...*

Portions of this newsletter are distributed to members-only. For more information on becoming a member visit our web site at [www.cisp.psu.edu](http://www.cisp.psu.edu) or contact Sharon Elder: [cisp@psu.edu](mailto:cisp@psu.edu)

## Upcoming Events

### March 20-23, 2005

PIM 2005  
San Diego, CA

### April 4-6, 2005

PM Asia 2005  
Shanghai, China

### April 20-21, 2005

Industry Member Meeting  
University Park, PA

### May 30-June 3, 2005

16th Int. Plansee Seminar 2005  
Reutte, Austria

### Aug 29-Sept. 1, 2005

Sintering'05  
Grenoble, France

PENNSTATE



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on laser process, novel processes. Most of the talks were non-commercial with a few exceptions but many papers were withdrawn. Missing from the meeting were a few power producers like Carpenter and Colmonoy, and carbide producers, who use coatings in their cutting inserts.

**PM 2004, World Congress of Powder Metallurgy**, Vienna, Austria, 17 - 21 October, attended by R. German, D. Heaney, J. Johnson, I. Smid, and students R. Bollina and R. Koseski. The meeting attracted 1000 registered participants. Participation from US registrants was the highest ever, with over 110 by MPIF estimates. R. German reported that his presentation on MIM and PIM markets was well attended, with over 200 people in the room. As is the case at many conferences, most of the important business was conducted in the hallways.

The Global Powder Metallurgy Property Database, a co-production of EPMA, JPMA, and MPIF ([www.pmdatabase.com](http://www.pmdatabase.com)) was on display. The intent of the database is to promote better design and utilization of PM. The CISP team tried it and found it slower than we anticipated. Continued access, input and interaction with users could improve this database to have it better serve the industry.

**Pacific Rim International Conference on Advanced Materials and Processing** –Beijing, China, 2-5 November, attended by Ivi Smid. There were ~1700 oral and poster presentations and an estimated attendance of 2000. The translation of Chinese papers to English is increasingly becoming an issue for scientists in the US. In the Soviet era, the US Department of Defense championed the monitoring and translation of selected Russian journals. Today, such an effort would be advisable with Chinese papers. An overwhelming number of presentations were from China and were at a respectable scientific level. At the level of the individual scientist, the Chinese university system is very competitive and the productivity in R&D is rather high.

**International Conference of Hard Materials**, San Juan, Puerto Rico – 8-12 November, attended by Rand German. This conference allows the scientific community to discuss updates, progress, and discoveries in hard materials. Attendance was over 100 paid registrants and probably 20 students with 77 presentations. Each of the major actors in hard materials had some presence either directly or via university contacts. As with all conferences, there was an element of “updates” or “new to you”.

A panel discussion listed some of the needs for the field as follows:

- microstructure gradients and identification of role in wear
- improved corrosion resistance in caustic, thermal cycling environments
- improved matrix phase to reduce loss of bonding phase in wear
- model for design of layers, thicknesses, and coatings to deliver desired properties
- improved coating process control (CVD texture, PVD cBN variant) need structure-property models for cutting edge breakdown
- need scientific underpinning for 200 nm WC-Co dense material improved chemistries designed for cutting Ti, stainless, cast iron

The panel stated that it took 10 years from innovation to practice. In ten years they think the field will be dominated by materials related to energy systems.

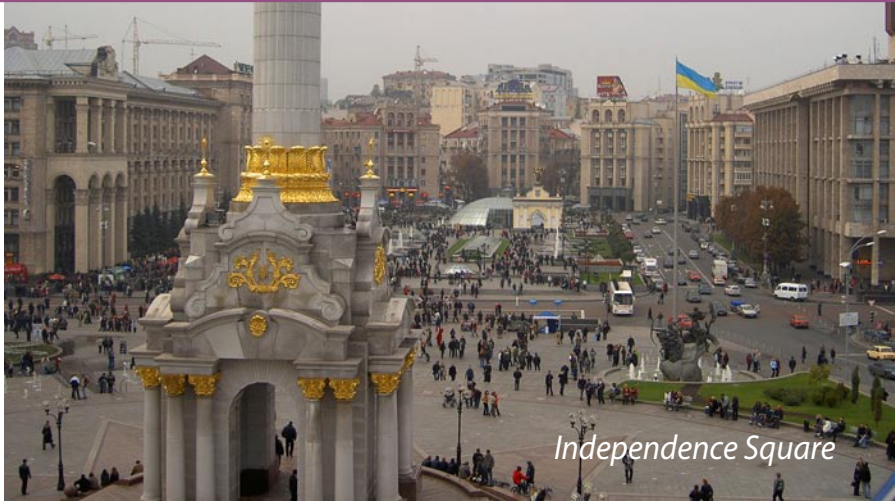
## **Defense Manufacturing**

**Conference, Las Vegas, NV, 29 November - 1 December**, attended by Don Heaney. This conference was an ITAR restricted conference and was attended primarily by Army, Air Force and DARPA agencies. Leaders from government, industry, and academia assembled to exchange perspectives and information relative to manufacturing technology, industrial modernization, and related DoD transformational initiatives. This year's theme “Advancing the Industrial Base to Support the Warfighter” set the stage for forum discussions concerning the defense industrial base and its impact on sustaining the U.S. warfighter, who is currently engaged in full-scale combat in Southwest Asia. Don presented a CISP developed technique for net shape manufacturing of W-based warheads.

Understanding how this global economy may unfold over the next few years is extremely important. Knowing what is happening at conferences is a good way to keep abreast. Success will come with the ability to use hard earned knowledge to keep moving forward. Sharon Elder, [cisp@psu.edu](mailto:cisp@psu.edu)

## **Hot Topics-PM Asia 2005**

PM Asia 2005 will be held in Shanghai from 4-6 April 2005. With every stand sold and the conference programme published, delegates are starting to sign up. Every indication is that this is going to be a successful event that will provide a commercial opportunity for Chinese and international companies to meet and discuss the realities of modern business against the backdrop of a conference featuring some of the leading names in the business discussing the hot topics of the day. Richard Felton, Editor MPR. [www.pmasia2005.com](http://www.pmasia2005.com).



Following PM2004 in Vienna, John Johnson, Senior Research Associate at CISP, visited the Frantsevich Institute for Problems in Materials Science (IPMS) in Kiev, Ukraine. Ukraine is undergoing dramatic change and Dr. Johnson's visit was just before the initial presidential election. Ukraine is the second largest country in Europe with a population of 48 million, and borders seven countries including Russia and three new European Union members (Poland, Hungary, and Slovakia).

Kiev has benefited from becoming a national capital, rather than being another city within the Soviet Union. Significant construction projects were evident everywhere in this hilly city of 3 million on the banks of the Dnieper River. Many of the cathedrals that were torn down in the 1930's have been rebuilt and contain museums with many displays having English captions. The streets were filled with a wide variety of vehicles. Russian-made Ladas were the most common, but many imported automobiles made by Volkswagen, BMW, Mercedes, Nissan, and Lexus were apparent.

Ukraine has traditionally had a strong P/M industry to produce parts for machinery for agriculture, coal and ore mining, and the light and food industry. A plant in Brovary, just 30 km east of Kiev, was one of the largest P/M plants in the world before the collapse of the Soviet Union, but is now only operating at about 10% capacity. Ukraine has not had much of an auto industry and most P/M parts for the automotive industry are produced from specialized Russian plants. However, several European car manufacturers are now doing final assembly in the Ukraine, which could help stimulate domestic part production.

IPMS was founded in Kiev in 1952 and has a long history of achievements in powder metallurgy. Classic work on activated and liquid phase sintering was conducted by well-known researchers, such as G.V. Samsonov, V.N. Ermenko, Y.V. Naidich, and I.A. Lavrinenko. At its peak during the Soviet-era, IPMS employed over 4000 people with about 80% of the work devoted to defense.

IPMS currently employs about 1400 people in more than 40 departments covering over 72,000 m<sup>2</sup>. Research is focused more on industrially-relevant projects and commercialization opportunities. International partners are involved with 55 projects. P/M is one of seven main thrusts,

which also include physical and solid state chemistry, solid-state physics and physical metallurgy, high melting temperature materials, hydrogen storage materials, nanosystems, and computer modeling of materials and processing.

P/M projects include development of rheological sintering models, jet-milling of MIM-grade powders, and water atomization of aluminum alloys. IPMS is also producing 100-200 g/day of multi-walled carbon nanotubes. Other projects include development of ternary ceramic and metallic phase diagrams, fuel cells, thermal barrier coatings, hydroxyapatite (HO) and HO composites, Ti-Si-X, Ti-B-X, and other Ti alloys, self-propagating high-temperature synthesis (SHS) of SiC-C, and rate-controlled sintering of SiC-C with Si<sub>3</sub>N<sub>4</sub>.

CISP has been evaluating jet-milled Cu powders produced by IPMS and has found that they provide good rheological properties, sinter well, and have high purity for high thermal conductivity. IPMS is moving forward with plans to begin production scale up of the process. A combination of new technology, such as MIM, new P/M materials, international collaboration, and new industrial investment are key to growth of Ukraine's PM industry. John Johnson: [jlj120@psu.edu](mailto:jlj120@psu.edu)



Dr. Johnson with Scientific Deputy Director Andrey Ragulya, Frantsevich Institute for Problems in Materials Science.



## Student Corner



Ryan  
Koseski

Ryan Koseski completed his master's degree in December 2004 at CISP. He graduated as an undergraduate in chemical engineering at Penn State in December 2002, and for almost a year worked as an assistant at CISP before enrolling as a student. His master's thesis

is entitled "In situ monitoring of dimensional change of powder compacts during thermal debinding." Part of his work was presented at the PM2004 conference in Vienna, Austria in October. He has aspirations of continuing his research in thermal debinding through the use of the equipment he designed and new debinding capable equipment recently received from Abbot Furnaces, St Marys, PA. His laser dilatometer is available for testing, and Ryan can be contacted for information as to the full range of capabilities of the equipment. He plans to continue his research over the next few years working toward a doctorate degree and is interested in expanding his experience in research through internships over the next year or two. Ryan Koseski (rpk128@psu.edu).

## Laser Dilatometer Studies Dimensional Behavior

A non-contact laser dilatometer capable of debinding powder compacts with high volume fractions of binder, including powder injection molding samples, has been designed, built and operated at the CISP laboratories. Initial testing has included samples that range from compacted, lubricated cylinders to standard test specimens of injection molded components. One of the unique features of the furnace is its ability to operate under a nitrogen atmosphere. The dilatometer measures the horizontal dimension of a sample during a heating cycle that can be programmed to follow treatment cycles common to production including ramping, and high temperature holds. The maximum temperature of the equipment is about 550°C. Currently, the equipment is being used to study the dimensional behavior of compacted parts with higher volume fractions of lubricant/binder polymer systems. The dilatometer has been used to observe the shrinkage during debinding caused by the presence of liquid binder in between the particles. When coupled with thermogravimetric and differential scanning calorimetry data, this equipment is very useful in observing the response of a compact system to burnout and debinding cycles. The equipment is available for testing. Ryan Koseski (rpk128@psu.edu)

## MRI Technical Award Winner

Congratulations to our Senior Research Technologist, Lou Campbell for winning the PSU Materials Research Technical Award for 2004.

This competitive award is given annually to an outstanding technical support staff involved with the Materials Research Institute. Lou received the award for his excellent core skills in materials characterization and data analysis and professional demeanor. Consideration for the award requires a letter of nomination and three additional letters of support.

Quoting from the support letter of Ryan Koseski, recent master's graduate and current PhD student, "I have been trained by Lou on virtually every piece of equipment that I have operated in those two years. His training method not only includes proper use, but also the fundamental theory and operation of the machines that produce our data. This extra effort to make us aware of what is actually being performed is, in my opinion, why our lab enjoys very little equipment down time and exceptional equipment life." And from Dr. Pin Yang, Distinguished Member of the Technical Staff of Sandia National Laboratories, "Lou has introduced us to many powder characterization techniques and rheological measurement methods, which are critical to the success of our project.--- His positive attitude has created a pleasant experience in working with the Pennsylvania State University."



(Left) Carlo Pentano, Director of MRI presents Lou Campbell with Research Technical Award



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