Winter 2008

Center for Innovative Sintered Products

CISP

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Director's Message

In our last CISP newsletter we discussed a focused effort in Refractory and Hard Materials. CISP and some of its member companies have determined a need for an academic focus for Refractory and Hard Materials in North America. Refractory and hard materials companies produce strategic, high value added products, and provide high-skill, high-wage jobs. The competitiveness of these companies depends upon sustained industry and university-based research, and a supply of skilled workers from technicians through Ph.D. levels. CISP and Penn State's Industrial Research Office, with a grant from the Kennametal Foundation, has begun a study aimed at examining the research and education needs of refractory and hard materials companies, identifying capabilities for meetings those needs, and creating a plan for organizing and sustaining a consortium structure to meet the technology and workforce development needs of U.S. refractory and hard materials industries.

The Grant, "Assessing and Addressing the National Need for Post-Secondary Education and Research in Refractory and Hard Materials," will be carried out over a 24-month period with the following schedule.

Activity 1: Assess industry research and workforce development needs (January 1, 2009 – December 31, 2009)

This task will involve conducting opinion surveys and one-on-one interviews with technology and human resource officers within leading U.S. refractory and hard materials companies to determine research and workforce development needs. Meetings will also be organized bringing together industry representatives to present the preliminary findings and obtain feedback and clarification. The results of this task will include a compilation of workforce skill deficits and research projects that could be addressed via new education and research programs initiated through an industry led, university based consortium.

Activity 2: Organize a consortium of companies, universities, and others (January 1, 2010 – December 31, 2010)

The education and research needs identified through Activity 1 will be used as the basis for organizing an industry-led, university-based consortium aimed at enhancing competitiveness of the refractory

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Members' Insider

Portions of this newsletter are distributed to members only:

- ***Lithographic Scale Metallic Component Fabrication Utilizing . . .***
- ***Optimization of High Speed Wire Drawing Using Finite Element . . .***
- ***Fracture Testing and Atomistic Modeling Techniques for Fracture. . .***
- ***Image Analysis of WC-Co Toughened with Alumina Particles***

For more information on becoming a member, visit our web site at www.cisp.psu.edu or send an email to cisp@psu.edu

Inside This Edition

The FCT Systeme GmbH SPS machine has arrived. Please join us at our April CISP meeting to learn more about the machine and to take a look first hand. To schedule an appointment contact Don Heaney, dfh100@psu.edu.

Upcoming Events

January 18-23, 2009
33rd International Conf. & Exh. on Adv. Ceramics & Composites
Daytona Beach, FL
www.acers.org

March 2-5, 2009
PIM 2009
Lake Buena Vista, FL
www.mpif.org

April 13-14, 2009
PSU Materials Day
University Park, PA
www.mri.psu.edu/news.asp

April 15-16, 2009
Industrial Members Meeting
Days Inn State College
University Park, PA
www.cisp.psu.edu

June 28-July 1, 2009
PowderMet2009
Las Vegas, NV
www.mpif.org

PM Industry Global Competitiveness Study

Penn State's Office of Economic and Workforce Development (OEWD) is partnering with the powdered metallurgy (PM) industry to analyze the industry's global competitive position to help individual firms and the entire PM industry make a strategic response to the pressures and opportunities that the future will bring. The aims of the competitiveness study are to obtain, organize, synthesize, and report information about five competitive forces that define the capability of PM part manufacturers in north central Pennsylvania to serve their customers and make a profit.

Entry of new competitors — The potential of profitable markets will draw firms to the PM industry. New entrants can bring additional capacity to the PM industry, capture market share from incumbents, bid down industry prices, or inflate incumbents' costs, and, in these ways, effectively decrease profitability of incumbents.

Bargaining power of customers — Information about the bargaining power of customers describes the way product markets function in the PM part manufacturing industry. In some cases, buyers might have the ability to drive the industry's prices down, bargain for more or better service at the same or lower prices, and pit firms in the industry against one another. Significant bargaining power held by customers can exercise tight discipline on PM part manufacturing industry profits.

Bargaining power of suppliers — Information about the bargaining power of suppliers describes the way resource markets operate in the PM part manufacturing industry. Suppliers of raw materials, components, services, and expertise can exert power over the PM part manufacturers. For example, suppliers can raise prices in response to changes in their own markets, or they can reduce the quality of their products without reducing prices. At the extreme, suppliers might refuse to work with a firm, or they might charge excessively high prices for unique resources. All things being equal, when few suppliers are available, few supply substitutes exist, and costs to the PM part manufacturing industry for switching suppliers are high, suppliers hold strong bargaining power.

Threats and opportunities of substitute products — Products that are substitutes for PM parts increase the propensity of customers to switch to alternatives in response to price increases. A high elasticity of substitution for PM parts by product alternatives can limit the potential returns in the PM part manufacturing industry by capping PM part price increases. Attractive price/quality substitutes for PM parts can place a firm lid on industry profits. Just as substitutes for PM parts can affect sales of PM parts, opportunities for substitution of PM parts in other industries are possible.

Competitive rivalry within the industry — Rivalry is a major determinant of the competitiveness among firms within many industries. Rivalry for advantage in product and resource markets often occurs along price dimensions as a method for increasing market share or penetration. Sometimes rivals compete aggressively on non–price dimensions such as innovation, marketing, branding, public recognition, and so forth.

For more information on how you can participate in this study, please contact Rose Baker, Director, Center for Regional Economic and Workforce Analysis at 814-865-9919 or rbaker@psu.edu, and David Passmore, Director, Institute for Research

Summer Study Abroad Programs - Spain

This past summer the National Science Foundation funded an international research program through Dr. Randall German and the Center for Advanced Vehicular Systems (CAVS) at Mississippi State University. The program was held at University Carlos III in Madrid, Spain under Dr. Jose Torralba. Throughout the six week rotational program we were exposed to many different aspects from the production of powdered metal products to the microstructural analysis of finished parts. A main focus was on the production and analysis of low cost titanium alloys (Ti-Fe) and the effects that heat treatments have on the formation of alpha and beta phases. Interacting with researchers in a different country helped give an idea on how international collaborations can be beneficial to both parties involved. *For more information, contact Daniel Cunningham, djc292@psu.edu.*

Summer Undergraduate Research Experience

During my summer at the CISP laboratory I gained valuable experience. Knowing I would be here for summer classes, I searched for an undergraduate research position on campus. Dr. Smid, CISP Associate Director, hired me after meeting with him and several of the graduate students. The majority of my work was done with a composite hard metal. At my request, I was able to focus on the mechanical testing of composite hard metals, which provided great experience for my Civil Engineering Major with a focus in structures.

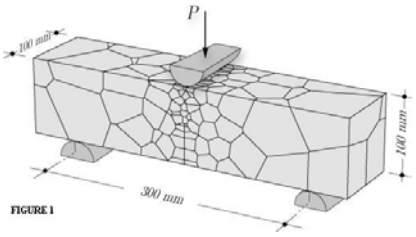

Figure 1 : *Irregular lattice model of cohesive cracking.* http://cee.engr.ucdavis.edu/faculty/bolander/cohesive.html

My experience at CISP has been positive. The greatest thing I learned was to be independent and manage time efficiently. When we received samples, we were given delivery dates and tests to be performed. These were typically mechanical testing and analysis of the samples. Three point flexure tests were performed. A three point flexure test applies a load to the top face of a sample until a breaking point is reached. The setup of this experiment is illustrated in Figure 1. This helped to provide excellent data regarding the strength of the material as samples were often resilient to loads up to 10,000kip. Figure 2 shows the type of data obtained from these tests. In addition to the three point flexure tests, I dealt with the testing of Archimedes density and Vicker's hardness. Both of these tests are vital for determining the longevity of the metal and helped to compare various samples in determining which one would be most effective. The Vicker's test begins by placing a sample on a staging area and a microscopic diamond is forced into the sample. Afterwards, the indentation is viewed on a screen and the measurements of the mark are derived to obtain the Vickers Hardness.

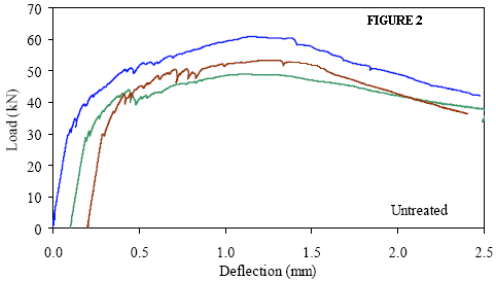

Figure 2: *Material Property Characterization of Ultra-High Performance Concrete.* US Department of Transportation Federal Highway Administration.

When I first came to CISP for my introduction, I was a bit overwhelmed by all of the equipment and operating procedures. Initially, my expectations were fairly simple in hoping that I'd gain experience in a laboratory setting while being able to maintain my grades in the summer class I was taking. These expectations were met and even exceeded in some areas as I consider this a summer well spent. What had the potential to be a boring, unproductive summer turned into a great experience.

Regarding the quality of the research, facility, and people I believe this was the best opportunity available during the summer here in State College. Although meeting Dr. Smid and his graduate students initially made me nervous, their outgoing personalities and approachability made the summer easy. Dr. Smid was often teaching his summer class, however when I would see him he was more than friendly and inquired how the work was going. The graduate student who I mostly interacted with was Erik Byrne. Erik was very helpful as he provided guidance in my research while simultaneously working on his thesis. I would recommend CISP to any undergraduate who is seeking experience in a lab setting. *For more information on how you can become involved, contact Ivi Smid at 814-863-8208 or smid@psu.edu.*

Anthony Kmetz <aak5011@psu.edu>

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and hard materials industry. This will involve visiting prospective industrial members, post-secondary institutions possessing relevant capabilities, and state and federal government agencies that may be potential partners, and organizing a series of planning meetings that bring these organizations together for discussions of how a consortium might be organized and sustained. The outcomes of this task will consist of additional statistical data on the refractory and hard materials industry, a comprehensive list of prospective consortium members, negotiated membership terms and conditions, and letters of commitment from prospective industry university, and government members.

Activity 3: Prepare a research and workforce development plan
(January 1, 2010 – December 31, 2010)

Based on results from Activities 1 and 2 above, a plan will be developed to address industry research and workforce development needs. Examples of technical areas of need that have already been identified include materials design, coatings and morphology, wear and corrosion, tribology, characterization, mechanical behavior, and modeling, among others. This activity will expand and elaborate upon this preliminary list. The results of this activity will be a multi-year plan of work and funding strategy for research and educational programs to address needs of the refractory and hard materials industry.

CISP will be contacting refractory and hard materials companies to determine research and workforce development needs over the next 12 months. We also ask you to contact us directly and pass this information onto other's in the refractory and hard material's industry that may benefit from this effort to offer us support in this program and to get your companies insight for the structure of this consortium. *For more information on how you can become involved, contact Don Heaney at 814-865-7346 or dfh100@psu.edu.*

Testing Services - Particle Size Analysis

CISP offers multiple ways of measuring particles. CISP performs 60 -100 particle size tests for industrial clients annually. A few of these sizing techniques are highlighted in this article.

Coulter LS230 Laser Scattering Particle Size Analyzer

- 0.04 µm to >2000 µm
- Scattering pattern converted to particle size by application of Mie and Fraunhofer theories.
- Dry or wet feed system

Coulter N4 Plus

- 1 nm to 3000 nm
- Particle size analysis by Photon Correlation Spectroscopy
- Measures Brownian Motion of suspended particles with laser and detectors

Coulter Multisizer II

- 0.8 µm to 400 µm
- Particle size analysis by electrical zone sensing
- Passes suspension of particles through electric field across an aperture
- Measures each particle individually for population data

Horiba CAPA-700

- 0.1 µm to 300 µm
- Particle size analysis by sedimentation
- Gravitational sedimentation for particles 30-300 µm
- Centrifugal sedimentation for particles 0.1-30 µm

For more information, contact Kristina Cowan-Giger at 814-865-1393 or kcc126@psu.edu. You can also visit our testing services website at http://www.cisp.psu.edu/testserv.

A Look at Engineering Salaries

Even with the recent economic crunch facing the US and the globe, an interesting trend for the hiring of engineering students has been observed. Our CISP students are having no problem finding jobs both at the graduate level and undergraduate level. The students often have multiple offers to choose between and the job offers have been very strong, suggesting that a shortage of trained technical people exists. I have also taken a few phone calls from industrial colleagues where they asked me what a typical engineering salary is these days. This prompted me to do an evaluation of salaries by region. The results are not so surprising, but I will let you be the judge.

Table 1: Average US Salaries for US Engineers.

Mechanical Engineer	$63,000
Electrical Engineer	$63,000
Civil Engineer	$58,000
Engineering Technician	$43,000
Manufacturing Engineer	$54,000
Software Engineer	$75,000

Table 2: Average Salary for Engineer's based on Geographic Location.

Location	Average Mechanical Engineer Salary	Average Manufacturing Engineer Salary	Average Engineering Technician Salary
Saint Marys, PA	$60,000	$52,000	$42,000
Pittsburgh, PA	$59,000	$51,000	$41,000
Columbus, OH	$63,000	$54,000	$43,000
Chicago, IL	$69,000	$59,000	$47,000
San Diego, CA	$70,000	$60,000	$48,000
Portland, OR	$67,000	$58,000	$46,000
Dallas, TX	$64,000	$55,000	$44,000
Newark, NJ	$79,000	$68,000	$54,000
Buffalo, NY	$60,000	$52,000	$41,000
Saint Louis, MO	$62,000	$54,000	$43,000

In general, the average salary for engineering jobs in the US is $64,000. Note that the average engineering salaries can vary greatly due to industry, company, experience, location, and benefits. As noted in Table 1, Manufacturing Engineers make the least and Software Engineers make the greatest salaries on average. Table 2 shows the salaries for different US locations; the general trend is that higher population areas offer higher salaries. Table 3 shows the effect that an MBA degree can have to your salary. A boost of about $17,000-$20,000 can be expected with an MBA degree. Data for this analysis was obtained through www.simplyhired.com. *For more information, please contact Don Heaney at 814-865-7346 or dfh100@psu.edu.*

Table 3: Average Salary for MBA based on Geographic Location.

Location	Average MBA Salary
Saint Marys, PA	$77,000
Pittsburgh, PA	$76,000
Columbus, OH	$81,000
Chicago, IL	$88,000
San Diego, CA	$90,000
Portland, OR	$86,000
Dallas, TX	$82,000
Newark, NJ	$101,000
Buffalo, NY	$77,000
Saint Louis, MO	$80,000

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