In The News

Recent Conferences

Workshop in Environmental Barrier Coatings

6-7 November 2002, Nashville, Tennessee

The agenda items for the "New Developments in Silicon Nitride and Environmental Barrier Coatings for Microturbine and Industrial Gas Turbine Hot-Section Components Workshop" were:

- Welcome and Workshop Goals, Debbie Haught, U.S. Department of Energy
- Advances in the Development of Silicon Nitride and Other Ceramics, Mark van Roode, Solar
- Si_3N_4 Materials Development at Saint-Gobain, Vimal Pujari, Saint-Gobain
- SiAlON Materials Development at Kennametal, Russ Yeckley, Kennametal
- Silicon Nitride Production Readiness Campaign, Bjoern Schenk, Honeywell
- Injection Molded Si_3N_4 for The Personal Power and Heat, a 7.5 kW Cogeneration Unit, Peter Kuypers, Innotech Europe
- Additive Effects on Si_3N_4 Oxidation/Volatilization in Combustion Environments, Beth Opila, NASA
- EBC and Material Requirements for Microturbines—A Detailed Analysis, John Holowczak, UTRC
- EBC Development Challenges, Bjoern Schenk, Honeywell
- EBC Development for Microturbines, David Mitchell, GE
- Historical Perspective of EBC Development, Dave Carruthers
- UTRC Environmental Barrier Coating Development and Demonstration, Ellen Sun, UTRC
- Slurry-Based EBC Concepts, Beth Armstrong, ORNL
- Oxidation Resistant Si_3N_4 Modified with Transition Metal Diborides, Ina Talmy, Naval Surface Warfare Center
- Polymer-Derived Graded Interfaces for EBCs, Rishi Raj, University of Colorado
- Tantalum Oxide-Based Environmental Barrier Coatings, Kathy Faber, Northwestern University
- Pack Cementation/Conversion Concepts, Rick Lowden, ORNL
- Processing and Properties in Si_3N_4 Matrix Composite Coatings & Joints From Filled Preceramic Polymer Systems, Rajendra Bordia, University of Washington
- Geomimetic and Kinetically Stable EBCs Derived From Polymer Precursors, Charles Lewinsohn, Ceramatec Inc.
- Potential EBCs from the R-Si-Al-O-C-N System, Roger Wills, University of Dayton
- Oxidation Resistant Coatings by Combustion CVD, Subu Shanmugham, Combustion CVD
- Collaborative Evaluation of EBCs in the Keiser Rig, Karren More, ORNL
- Mechanical Property Characterization of EBCs, Matt Ferber, ORNL
- Development of NDE Techniques for EBCs, Bill Ellingson, Argonne National Laboratory
- Discussion/Workshop Summary (Develop Recommendations and Action Items), Dave Stinton

Contact: Dave Stinton or Roxanne A. Raschke at Distributed Energy Resources Materials Research, Oak Ridge National Laboratory, P.O. Box 2008, Bldg. 4515, MS-6065, Room 207, Oak Ridge, TN 37831-6065; tel: 865/574-8860; fax: 865/241-0411; e-mail: raschkera@ornl.gov.

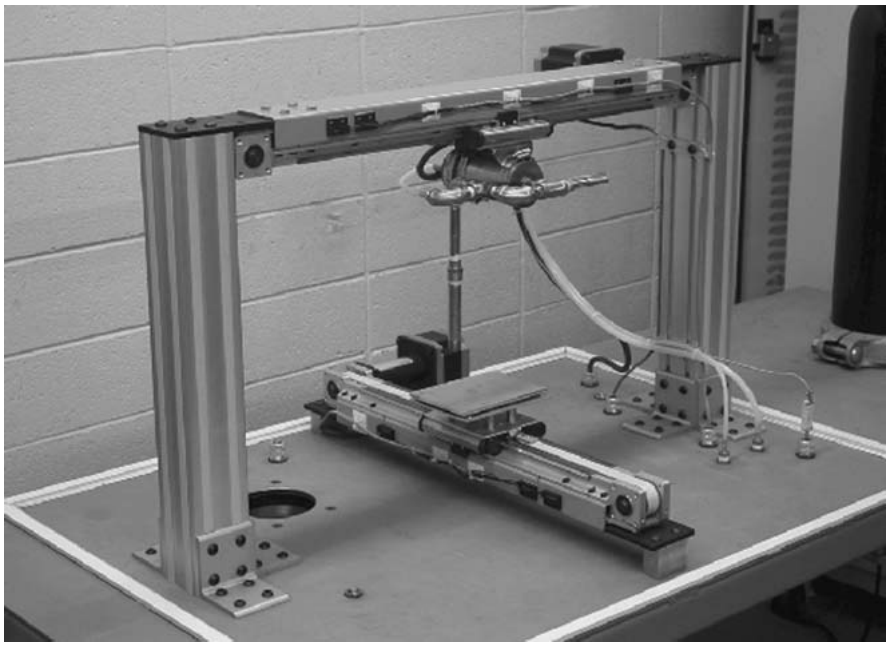

Fig. 1 KM R&D unit for metal deposition with rudimentary NC

Kinetic Metallization

Inovati (Santa Barbara, CA) has successfully developed a low-temperature metal deposition technique called kinetic metallization (KM). Winner of a 2002 R&D 100 award, KM is capable of depositing fully dense, adherent coatings of a variety of metals on standard metal surfaces without costly surface preparation. Coatings of pure copper, stainless steel, nickel, chromium, aluminum, cobalt, titanium, niobium, and other metals, as well as alloys based on these metals are possible on such surfaces as steel, aluminum, titanium, copper, brass, and so forth. Additionally, braze powders (e.g., silver, copper, aluminum, or nickel base) can be sprayed out onto parts to be joined, and coatings have also been demonstrated on ceramic substrates. The feedstock material for KM is powder. The cost of KM is comparable to competitive processes. Applications include preparing corrosion- and/or wear-resistant surfaces for parts, machinery, and equipment. Decorative coatings are also deliverable. Of particular interest has been the successful deposition of the highly wear-resistant material WC-17% Co.

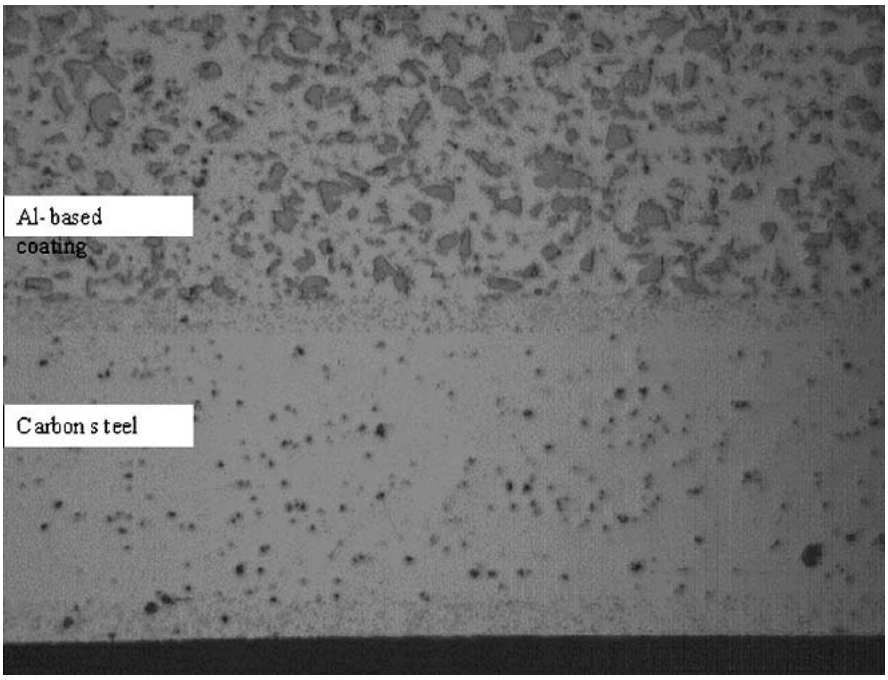

Fig. 2 Aluminum-base composite coating deposited onto plain carbon steel. 100×

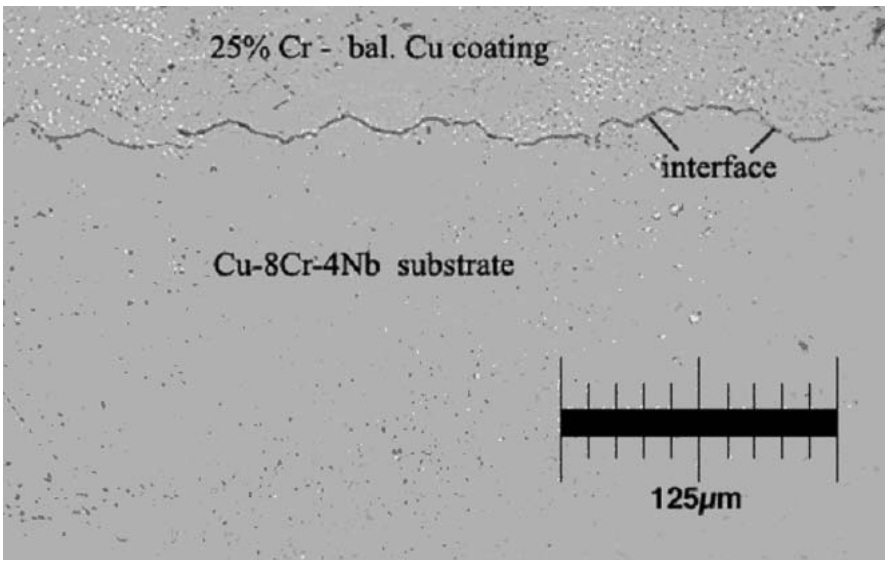

Fig. 3 KM coating of 25% Cr, balance copper deposited onto copper alloy. 400×

Since the powders are deposited at well below their respective melting points, the coatings exhibit very fine grain size and one can avoid heat distortion of the workpiece being coated and interdiffusion of multilayer coatings. Spray forming of such metals as pure aluminum and Al-SiC composite has also been successfully carried out with fine microstructure in the final material.

One successful application has been the spraying of aluminum grounding strips on steel telecommunications equipment racks made by Hendry Telephone Products. Inovati has received federal R&D contracts from the Ballistic Missile Defense Organization (BMDO), U.S. Army, and U.S. Navy. In addition, the Australian Navy recently tested a KM sprayed aluminum coating on a magnesium alloy that showed excellent salt-fog corrosion resistance up to 168 h compared to 12 h for a standard chromate coating. Other applications can include replacement of organic plating (e.g., hexavalent chrome).

Inovati is now making an R&D KM spray unit available for university purchase and is set up to both contract coat and to sell spray coating equipment and consumables for KM.

Contact: Howard Gabel, President, Inovati, P.O. Box 60007, Santa Barbara, CA 93160-0007; tel: 805/571-8384, ext. 1; e-mail: hgabel@inovati.com; Web: http://www.inovati.com/.

News from NASA

Scanning Thermography

Scanning thermography is a noncontact, nondestructive technique that makes it possible to find defects hidden inside structural components in a variety of settings. Scanning thermography can be used to perform inspections of objects that may have large areas and a variety of shapes and that are found in a variety of settings that include, but are not limited to, production lines, industrial tanks and pipes, aircraft, power plants, and bridges. Scanning thermography is applicable to diverse structural materials, including metals, plastics, laminated polymer-matrix composites, and bonded aluminum composites, to name a few. Defects that can be detected by scanning thermography include cracks, disbonds (delaminations), corrosion, and wear.

In scanning thermography, both a source of infrared radiation and an infrared camera are mounted together near an object to be inspected and are kept at constant distance from the object while they are moved together along the surface of the object. The infrared camera images the temperature of the region behind the moving source. The output of the infrared camera is digitized and sent to an image-data processor, which computes spatial variations of temperature across the imaged portion of the surface area. Spatial variations of temperature indicate spatial variations of heat capacities. Because portions of the object that contain damage, corrosion, or delaminations are thinner, and therefore have a reduced thermal mass relative to portions that do not contain such defects, they exhibit corresponding differences in temperature. The resulting temperature map can be examined and/or the digital output of the image-data processor can be processed further to diagnose the structural degradation.

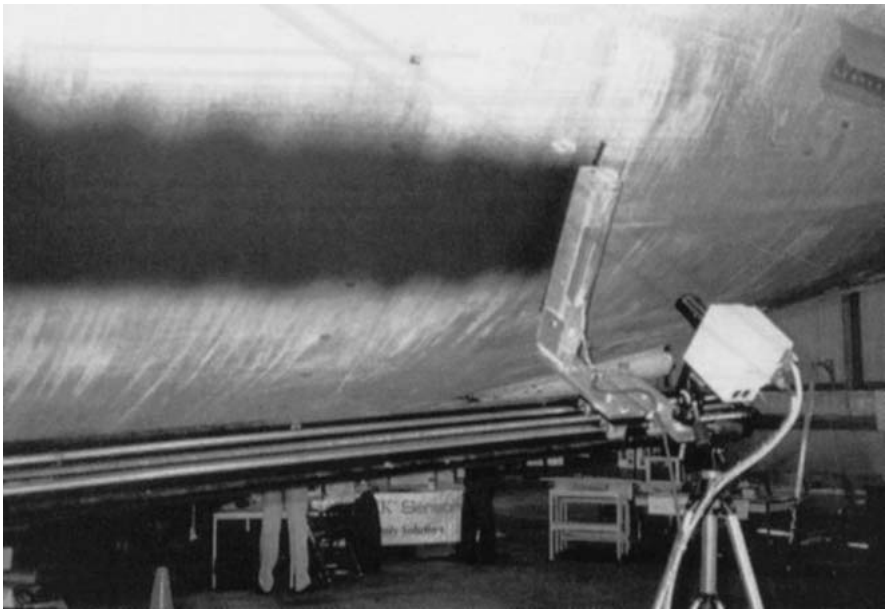

Fig. 1 Scanning thermographic apparatus used to search for defects in the fuselage of a passenger plane

A scanning thermographic apparatus (Fig. 1) is highly portable. It can scan the surface of an object to be inspected at a rate about six times that of a conventional thermographic apparatus. More specifically, it can scan at a speed that can be varied up a maximum of >6 ft/s (>1.8 m/s). This is fast enough that power-plant boilers, for example, are now being inspected by scanning thermography in a fraction of the time needed for inspection by prior techniques.

Improvements in efficient utilization of the thermal source have increased the signal-to-noise ratio, significantly improving the quality of the postprocessed image data. Compilation of the image data provides a comprehensive archive—an inspection record that can be reviewed over time to provide a means of monitoring the evolution of damage within a particular structure.

This work was done by K.E. Cramer and W.P. Winfree of Langley Research Center. For further information, access the Technical Support Package (TSP) free on-line at www.nasatech.com/tsp under the Physical Sciences category. Excerpted from *NASA Tech Briefs, 26*(1), Dec 2002, p 44-45.

New Products and Industry News

Hardsurfacing Alloy for Petrochemical, Mining, and Other High-Impact and High-Abrasion Applications

As part of its application-specific product development initiative, Wall Colmonoy has released a new material specifically developed for demanding petrochemical, mining, and aggregate processing applications where both impact and abrasion are constant problems.

Colmonoy 80PTA is a unique composite material containing a high volume (60%) of extremely abrasion-resistant tungsten carbide particles (3500 DPH) in a soft (30 HRC) impact-resistant nickel-base matrix alloy. The tungsten carbide provides abrasion resistance, while the nickel matrix has excellent ductility and impact resistance. The nickel-alloy matrix and the tungsten carbide particles are uniquely matched so that a high volume percent of carbide grains are uniformly distributed throughout the matrix alloy.

Developed for application with highly efficient plasma transferred arc (PTA) deposition equipment, the material is supplied as powder with a uniform size distribution for reliable PTA application.

Contact: Rick Hedden, Corporate Director, Marketing and Planning, 30261 Stephenson Hwy., Madison Heights, MI 48071-1650; tel: 248/585-6400, ext. 233; fax: 248/585-7960; e-mail: rhedden@wallcolmonoy.com.

Awards Information

ASM TSS Appreciation Awards

At the ASM Thermal Spray Society Board meeting on 6 October 2002 (Columbus, OH), ASM TSS Past President Albert Kay, FASM (ASB Industries, Barberton, OH), presented appreciation awards to the following individuals.

Paul A. Kammer

Paul A. Kammer, FASM (Kammer Associates, New Bern, NC), received an appreciation award for his leadership and inspiration in the formation of the ASM Thermal Spray Society and for his valuable contributions as Board Member, Vice President, President, and Past President from 1994-2002.

George A. Blann

George A. Blann (Buehler Ltd., Lake Bluff, IL), Chairman of the TSS Accepted Practices Committee on Metallography (not present at the meeting), received an appreciation award for his service as Chairman to the TSS Awards Committee from 1999-2002.

Richard Knight (Drexel University, Philadelphia, PA), Vice President of the ASM TSS Board, was presented with an appreciation award for his dedication and service as Chairman of the ASM TSS Training Committee from 1997-2002.

Richard Knight

Linde Enters North American Thermal Spray Market

Linde AG, Linde Gas Division, one of the largest gas suppliers in the world, is intensifying its presence in the North American thermal spray market. The merger between two large and successful gas companies, Linde and AGA, several years ago further strengthened Linde's U.S. ability to provide customers help in improving their day-to-day operating productivity with thermal spray techniques.

Having won the support of Sulzer Metco and ASB Industries, Linde's European technical and commercial specialists conducted a thermal spray training program for Linde's U.S. sales representatives in Cleveland, OH, from 5 to 6 September 2002. More than 30 attended the two-day "retreat," undisturbed by mobile phones or other business distractions. Peter Heinrich and David Park from Linde/AGA organized the seminar.

Expertise and practical advice were provided by the speakers, Albert Kay, owner of ASB Industries in Akron, OH, and Dr. Montia Nestler, Jeffrey S. Molchan, and Chris Dambra from Sulzer Metco in Westbury, NY. Werner Krömmer and Peter Heinrich from Linde AG, Linde Gas Division, Germany were responsible for the training content.

One of the objectives of this training conference was to provide an exchange of experiences on the U.S. market and the market's behavior. Also discussed was the extensive customer research, problem solving, and gas supply design capabilities offered by the thermal spray lab at the

Fig. 1 Montia Nestler from Sulzer Metco

Fig. 2 The AGA-Linde training team

Fig. 3 Werner Krömmer

Fig. 4 Peter Heinrich explaining the principles of thermal spraying

Linde headquarters in Germany. The program included the following points:

- Basic information about thermal spraying
- Information on thermal spray market
- Applications
- Films: "Flame Spraying with Acetylene," "LINSPRAY High-Quality Coating," and "Cold Spraying"
- Which products does Sulzer Metco offer?
- In which industries are these products applied?
- How does a job shop view the thermal spray market in the United States?

Montia Nestler, Albert Kay, Jeffrey Molchan and Chris Dambra discussed the future of thermal spraying. Peter Heinrich and Werner Krömmer focused on providing their American colleagues with the necessary help to establish Linde on the North American thermal spray market.

The Linde Applications Technology Center north of Munich has used thermal spraying in Europe since 1979. Research projects are carried out, and new processes for the application of gases are developed. The center analyzes the customer's problems and develops solutions, which are then implemented under typical production conditions at the customer's site.

The lab is equipped with the latest technical facilities:

- State-of-the-art spray laboratory, complete with a soundproofing and exhaust system (10,000 Nm^3/h capacity) and compliant with the latest industrial health and safety requirements
- Five-axis spray manipulator for rotationally symmetric and plane parts. Maximum part dimensions: 1200 mm long, 1000 mm diameter; 800 kg maximum weight

The thermal spray systems available are:

Plasma spraying

- Metco EGN
- Gun Metco 9MB
- Gun Metco 3MB
- Gun PT R4

High-velocity oxyfuel flame spraying (HVOF)

- TopGun
- JetKote
- Diamond Jet Standard
- Diamond Jet with hybrid attachments 2600 and 2700
- OSU D11
- Kerosene gun Jet Met
- Metatherm HVOFW 1000
- High Velocity Techn. HVPW 2000
- Cold spraying

Flame spraying

- Various commercially available flame spray systems for spray materials in wire, powder and rod form
- Flame spraying with plastics
- Equipment for low-melting-point materials

Practical Applications

- Practical investigations to determine optimal spray parameters
- Assistance with the development of new thermal spray applications
- Tests in their modern laboratory in the "Linde Applications Technology Center"
- Tests on customers' premises with their own equipment

Fig. 5 Al Kay (center) and thermal spray enthusiasts

- Tests on customers' premises with mobile spray equipment
- On-site fusing of rotationally symmetric parts of up to 500 mm in diameter and 1200 mm in length using mobile fusing equipment

Thermal Spray Services

- Special gas supply systems for: HVOF spraying using propane with 7 bar pressure step-up, flame spraying with 1.5 bar constant dynamic acetylene pressure, acetylene at 2 bar (special supply), and plasma spraying, gas purity 5.0
- Design and construction of mechanized or controlled systems for fusing
- Automatic fusing system PEA 2
- Special-design torch for fusing of self-fluxing alloys
- Organization of thermal spray events, e.g., the HVOF Colloquium in Germany
- Film "Flame Spraying with Acetylene"
- Film "LINSPRAY High-Quality Coating"
- PC program for thermal spraying "LINSPRAY"
- Carbon dioxide cooling
- Activities in the field of European Standardization
- Activities within GTS, the "Association of Thermal Sprayers"
- A variety of publications
- PR activities
- On-line diagnostic for thermal spraying with particle flux imaging (PFI-LINSPRAY)

In addition, Linde also has experience related to the gases employed in thermal spraying, and it has carried out in-depth comparisons of these gases to provide the user of thermal spraying with the most suitable gas or gas mixture for his/her application and to supply the user of thermal spraying with the optimal hardware.

Contact: D.Z. Park, Manager Gas Marketing, AGA Gas, Inc. Member of Linde Gas Group; tel: 216/573-7897; e-mail: dave.park@us.lindegas.com; or Peter Heinrich, Manager Thermal Spraying, Linde AG, Linde Gas Division, Germany; tel: +49 89 31001 564; e-mail: peter.heinrich@lindegas.com.

News from ITSA and TSS

New ITSA Leaders

Effective 12 October 2002, John Read of National Coating Technologies in Winnipeg, Canada, has assumed the Chairman position for the International Thermal Spray Association, and Ed Simonds of Cincinnati Thermal Spray was elected the new Vice Chairman.

John Read

Read has a B.E. in Metallurgical Engineering (1966) from McGill University, Montreal, Quebec, and an M.E. in Metallurgical Engineering (1970).

Read worked as a Welding Engineer for Dominion Bridge Company Ltd in Lachine, Quebec, from 1968 to 1977. In 1977, he went to work for Air Liquide, Canada, as the Manager, R&D, Welding Products in Montreal, Quebec, until 1983, the Sales Manager, Welding Products—Western Region in Calgary, Alberta, until 1986, and General Manager, Midwest Area, Air Liquide Canada, Winnipeg, Manitoba, until 1989.

In 1990, he purchased 25% of a thermal spray job shop, National Coating Technologies, Inc., Winnipeg, Manitoba, and became Vice President and General Manager. In 1994, he and his wife, Mary Read, purchased the remaining shares, and he became President.

A long-time International Thermal Spray Association member, Read was elected Vice Chairman two years ago.

An ASM International member since 1963, Read served three years as Chairman of the ASM Manitoba Chapter and is currently Treasurer of both the Manitoba Chapter and ASM Canada Council. Read also served from 1976 to 1984 as Chairman of Canadian Standards Association W48 Committee on Welding Filler Metals.

"I am looking forward to helping ITSA maintain and expand its role as the voice of the commercial thermal spray community and to fostering an atmosphere of cooperation with ASM TSS, to the mutual benefit of both organizations," said Read.

Ed Simonds, new ITSA Vice Chairman, was born in upstate New York and attended the State University of New York at Albany. He started in thermal spray in 1981 as a Field Engineer for Perkin Elmer/Metco, was promoted in 1984 to Diesel Program Manager in the Marketing Department and Technical Program Manager in 1985. In 1988, Simonds became Sales Manager of Racine Flame Spray and then moved to Sulzer Plasma Technik in 1990 as Regional Sales Manager. When Sulzer purchased Metco in 1994, Simonds became Regional Sales Manager for the western United States. Ed joined Cincinnati Thermal Spray, Inc., in 1998.

Ed Simonds

"Having been involved in thermal spray sales from materials and equipment through coatings, I have particularly enjoyed and somewhat specialized my career in the development of applications and materials," said Simonds.

ASM Thermal Spray Society Board Members

From left (standing): J. Stricker, P. Fauchais, Z. Mutasim, E. Rybicki, R. Unger; (sitting): P. Hanneforth, C. Berndt, A. Kay, R. Knight. Not pictured: M. Dorfman, L. Moskowitz, M. Smith

Christopher C. Berndt, *Board President,* Associate Dean, College of Engineering and Applied Sciences, State University of New York at Stony Brook; tel: 631/632-8507; fax: 631/632-8525; e-mail: cberndt@notes.cc.sunysb.edu

Albert Kay, *Board Past President,* President, ASB Industries, Inc., Barberton, OH; tel: 330/753-8458; fax: 330/753-7550; e-mail: alkay2@ix.netcom.com

Richard Knight, *Board Vice President,* Research Professor & CPPM Director, Drexel University, Philadelphia, PA; tel: 215/895-1844; fax: 215/895-2332; e-mail: knightr@drexel.edu

Peter Hanneforth, *Secretary/Treasurer,* Vice President Global Marketing Sulzer Metco (U.S.) Inc., Westbury, NY; tel: 516/338-2211; fax: 516/338-2218; e-mail: peter.hanneforth@sulzer.com

Mitchell R. Dorfman, *Board Member,* Director Coating & Materials Development, Sulzer Metco (U.S.) Inc., Westbury, NY; tel: 516/338-2251; fax: 516/338-2488; e-mail: mitch.dorfman@sulzer.com

Pierre Fauchais, *Board Member,* University of Limoges, France; tel: 33 55 45 7435; fax: 33 55 45 7211; e-mail: fauchais@unilim.fr

Larry N. Moskowitz, *Board Member,* Senior Engineer, BP Corporation, Katy, TX; tel: 281/366-2924; fax: 281/366-7983; e-mail: moskowln@bp.com

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Joseph P. Stricker, *Board Member,* President, St. Louis Metallizing Co., St. Louis, MO; tel: 314/531-5253; fax: 314/531-3723; jpstricker@stlmetallizing.com

Robert H. Unger, *Board Member,* National Sales Manager, Praxair, TAFA, Concord, NH; tel: 603/223-2104; fax: 603/225-4342; e-mail: bob_unger@praxair.com

People in the News

Tucker to Serve ASM as Vice President

Robert C. Tucker

ASM International has elected Robert C. Tucker, Jr., a consultant in the areas of surface science and engineering, new technology assessment and business development, to serve as the Society's Vice President for 2002-2003. A long-time member of ASM, Tucker is a Fellow of the Society, served as President of the ASM Thermal Spray Society from 1996-1998, and served as a member of the ASM Board of Trustees from 1998-2001.

ASM TSS Appoints Dorfman to Board

Mitchell R. Dorfman, Director of Coatings and Materials Development, Sulzer Metco (U.S.) Inc., was appointed to the ASM Thermal Spray Society Board. Dorfman has been involved in the thermal spray industry for nearly 25 years, working with vendors, OEMs, universities, research institutions, and job shops. He is presently Chairman of the ASM TSS Information and Development Committee, has been a reviewer of technical papers for *Journal of Thermal Spray Technology,* served as Session Chairman at technical conferences, helped organize technical sessions, and has been an active member of the ASM TSS Training Committee. Dorman is also an ac-

Mitchell R. Dorfman

tive member of the ASM International Long Island Chapter, giving various technical presentations at the local chapter meetings. He has participated on various American Welding Society committees and is a member of the Materials Research Society and the American Ceramics Society. Dorfman was appointed to complete the term of Board Member Richard Knight, who became ASM TSS Vice President.

Wall Colmonoy Appoints Rangaswamy Director of Technical Services; Wilcox to Director of Product Sales

Wall Colmonoy Corporation announced two promotions in its Product Group. Dr. S. "Ranga" Rangaswamy has been appointed Director of Technical Services—Products Group, and Russ Wilcox has been appointed Director of Sales—Product Group. The Wall Colmonoy Product Group includes Colmonoy hard-surfacing alloys and Nicrobraz nickel-base brazing filler metals.

S.R. Rangaswamy

Rangaswamy will serve as the company's technical authority on both brazing and hard-surfacing materials and will support the company's R&D, sales, distribution, and customer groups. With a Ph.D. in materials science, he has authored many technical papers and holds several patents. He joined the company in 1996.

Wilcox was most recently the company Regional Sales Manager. In his current position, he will supervise the North American team and manage the company's worldwide distributor network. With 21 years of experience (17 with Wall Colmonoy), Wilcox's experience includes both technical sales and management. He has B.M.E. and M.B.A. degrees from Cleveland State University.

Russ Wilcox

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