In The News

New Literature

Materials, Finishing, and Coating

Volume 3, of *Tool an Manufacturing Engineering Handbook,* Hardcover, 864 pages. 453 illustrations, 318 tables, 60 equations. Edited by C. Wick and R. Veilleur. ISBN: 0-87263-176-1. Price: $126.00 (SME Members: $110.00).

Helps production teams use new materials, choose the most efficient surface and edge preparation techniques, and apply coatings that enhance the appearance and performance of the final product. Also helps them to analyze the machinability, formability, and weldability of materials and to assess heat treatment systems.

Contact: Society of Manufacturing Engineers, Attn.: Customer Service Center, P.O. Box 6028, Dearborn, MI 48121; tel: 800/733-4763.

Materials Crystal Chemistry

Relva C. Buchanan and Taeun Park, May, 1997/472 pages, illustrated. Price: $175.00 ($65.00 on orders of five or more copies, for classroom use only).

Materials Crystal Chemistry is a reference for inorganic chemists; materials scientists; materials, optical, chemical, electrical and electronics, design, and manufacturing engineers; ceramists; geologists; and physicists; and an indispensable text for upper-level undergraduate and graduate students taking courses in crystal chemistry and crystallography, structures of solids, or structure-property relationships in solids in departments of materials science or engineering.

Contact: Marcel Dekker, Inc., 270 Madison Ave., New York, NY 10016; tel: 212/696-9000, WWW: http://www.dekker.com.

The Metals Black Book—Ferrous Metals

Metals Data Book Series—Volume 1 contains more than 600,000 pieces of metals data covering carbon steels, alloy steels, tool steels, cast irons, and stainless steels, including boiler and pressure vessel steels. More than 1200 U.S. (ASTM, UNS, AISI, SAE, AMS, FED, MIL) and international (DIN, BS, NF, JIS, SS, GOST) cross references. More than 1000 ASTM and international (ISO, CEN, DIN, BS, JIS) specification designations and titles. Expanded metallurgy section covering: carbon steels, alloy steels, stainless steels, tool steels, cast steels, and cast irons. Glossary of terms in 4 languages (English, French, Spanish, and German).

Contact: CASTI Publishing Inc., 14820-29 St., Edmonton, Alberta, Canada T5Y 2B1; fax: 403/473-3359; tel: 403/478-1208. On CD-ROM $99.00; with book $134.00.

The Metals Red Book—Nonferrous Metals

Metals Data Book Series—Volume 2 contains more than 400,000 pieces of metals data covering aluminum, copper, nickel, titanium, zinc, tin (solders), precious metals, zirconium, and cobalt metals, and their alloys. More than 1200 U.S. (ASTM, UNS, UNS, SAE/AMS, MIL, FED) and international (CEN, DIN, BS, JIS, AFNOR, ISO) cross references of aluminum, copper, nickel, titanium, zinc, tin (solders), precious metals, zirconium, and cobalt metals, and their alloys. Nonferrous metallurgy chapters covering aluminum, nickel, titanium, refractory, reactive, lead, zinc, tin, and copper metals, and their alloys. Also includes precious metals and tungsten carbides.

Contact: CASTI Publishing Inc., 14820-29 St., Edmonton, Alberta, Canada T5Y 2B1; fax: 403/473-3359; tel: 403/478-1208. On CD-ROM $99.00; with book $129.00.

The Metals Blue Book—Welding Filler Metals

Metals Data Book Series—Volume 3 covers welding filler metals. Eight chapters of welding metallurgy including carbon steel, alloy steel, stainless steel, aluminum alloys, copper alloys, titanium alloys, and nickel alloys, as well as weld flaws and defects. All AWS welding electrodes, rods and wire chemistries and mechanical properties, including brazing filler metals and fluxes. Filler metal designations and titles for all AWS specifications and selected international standards. Cross references of selected international filler metals specifications. Glossary of welding terms in English, Spanish, and French.

Contact: CASTI Publishing Inc., 14820-29 St., Edmonton, Alberta, Canada T5Y 2B1; fax: 403/473-3359; tel: 403/478-1208. On CD-ROM $99.00; with book $129.00.

The Practical Guide to ASME Section II—1997 Materials Index

Practical Guidebook Series, Volume 1, author: Richard A. Moen. Contains: Introduction to the Materials Index; Organization of the ASME Boiler and Pressure Vessel Code From a Materials Standpoint; Organization and the Use of Section II, Part D; Evolution, Organization, and Use of ASME Materials Specifications; Code Alloys by UNS Numbers; Code Specifications by Nominal Composition for Grouped Alloys; Code Specifications by Common Name or Trade Name; Ferrous Materials Specifications by Code Section Use; Nonferrous Materials Specifications by Code Section Use; and ASME Materials Specification Designations and Titles.

Contact: CASTI Publishing Inc., 14820-29 St., Edmonton, Alberta, Canada T5Y 2B1; fax: 403/473-3359; tel: 403/478-1208. On CD-ROM $99.00; with book $134.00.

SSPC Publications

Volume One, *Good Painting Practice*, contains chapters that discuss the methods and equipment used for mechanical surface preparation, metallic and nonmetallic abrasives, field surface preparation costs, environmental and health concerns, wet blast cleaning methods, and other factors in surface preparation.

Volume Two, *Systems and Specifications*, contains every SSPC and SSPC/NACE joint surface preparation specification, as well as guides to SSPC visual standards; guides for the containment and disposal of surface preparation debris; SSPC commentaries, guides, and specifications for paint application, painting systems, and paints; guides on methods for improved coating performance; and standard procedures for evaluating the qualifications of industrial painting contractors.

Surface Preparation Specifications contains documents extracted from Volume Two, *Systems and Specifications*, contains all of the joint SSPC/NACE abrasive blast cleaning specifications and a recent joint technology update on thermal precleaning, as well as the SSPC specifications for hand-tool cleaning, power-tool cleaning, and power-tool cleaning to bare metal; the SSPC specification for mineral and slag abrasives; guides describing the use of SSPC visual standards; and the SSPC Surface Preparation Commentary.

SSPC-SP 12/NACE 5 specifies the surface preparation and cleaning of steel and other hard materials by high- and ultrahigh-pressure water jetting prior to recoating. SSPC-SP 12/NACE 5 is provided as a free supplement to both Volume Two, *Systems and Specifications*, and *Surface Preparation Specifications* but can also be purchased as a separate document.

SSPC Visual Standards are bound collections of standard reference photographs depicting various conditions of steel surfaces before and after cleaning in accordance with written SSPC surface preparation specifications. SSPC-VIS 1-89 illustrates surfaces cleaned in accordance with the SSPC specifications for white metal blast cleaning, commercial blast cleaning, brush-off blast cleaning, and near-white metal blast cleaning. SSPC-VIS 3 shows surfaces cleaned in accordance with the SSPC specifications for hand-tool cleaning, power-tool cleaning, and power-tool cleaning to bare metal.

Contact: SSPC, 40 24th St., 6th Floor, Pittsburgh, PA 15222-4643; tel: 412/281-2331; 800/837-8303; fax: 412/281-9992; WWW: http://www.sspc.org.

Bioceramics

Bioceramics, Volume 9, *Proceedings of the 9th International Symposium on Ceramics in Medicine*, 24-27 Nov 1996, Otsu, Japan. Edited by Tadashi Kokubo, Takashi Nakamura, and Fumiaki Miyaji-Kyoto, Elsevier Science Ltd. Hardbound, 556 pages. ISBN: 0-08-042684-0. Price: NLG309.00/US$240.00.

This book covers the whole area of ceramics for biomedical applications: fabrication processes, structure, physical and biological properties, and clinical applications. The ceramic materials covered include glasses, glass-ceramics, sintered oxide, and nonoxide ceramics, carbon, single crystals, cements, solution-derived ceramics, vapor-derived ceramics, and their composites with metals and organic polymers. The clinical applications include topics in orthopedic surgery, dentistry, oral and maxillofacial surgery, plastic surgery, general surgery, cardiovascular surgery, ophthalmology, otolaryngology, radiology, and neurosurgery.

The book contains 8 invited papers and 120 contributed papers. It features more than 220 high-quality photographs, an author index, and a keyword index. The following sections are included: Current Status and Future Trend of Ceramics in Medicine, Biology of Ceramics, Glass and Glass-Ceramics, Calcium Phosphates, Cements, Ceramics-Metal Composites, Ceramics-Polymer Composites, Dental Ceramics, Orthopedic Ceramics.

Contact: Elsevier Science, Regional Sales Office, Customer Support Dept., 655 Ave. of the Americas, New York, NY 10010; tel: 212/633-3730; fax: 212/633-3680; e-mail: usinfo-f@elsevier.com. Toll-free for customers in the U.S. and Canada: 888/437-4636. All other countries: Elsevier Science, Regional Sales Office, Customer Support Dept., P.O. Box 211, 1000 AE Amsterdam, The Netherlands; tel: +31-20-485-3757; fax: +31-20-485-3432.

Web Site News

TSS Bulletin Board

Look at the questions from Argentina, Australia, Belgium, Brazil, Canada, Chile, China, Czech Republic, Finland, France, India, Japan, South Korea, Malaysia, New Zealand, United Kingdom, Poland, Portugal, Russian Federation, Slovakia, South Africa, Spain, Sweden, Switzerland, and the United States.

What are your answers to the following questions?

- What type of heat and source of energy could potentially be used to transfer temperatures of 200, 400, and 600 °F on aluminum and steel substrates? The control area is 6 by 6 in. square, or 6 in. circumference. We would like to penetrate the substrates at various controlled depths within fractions of seconds.
- I would like information on the process of thermospraying chrome plating on the inside of hydraulic cylinders.
- I need to put Mo or Mo-Mo_2C or another coating on steel tube 4 to 6 in. inside diameter, by the HVOF technique. I need help to select the best equipment for this.
- What are suitable nonstick coatings with respect to sugar, wood, and sticks that can be sprayed on a 600 by 1500 mm thin iron plate. The coating used now is PETE, but the life length is not good enough and the coating may warp when heated. So, what about a process using thermal spray?
- What kind of coating and process can be used for replacing chrome plating on a plastic roll? These kinds of rolls should meet the needs of high

hardness, pore-free, chlorine corrosion resistant, and can be polished to less than 12 grade.

- What is considered to be a safe maximum gas or liquid pressure for a HVOF or D-gun WC/Co or WC/CoCr type coating on an axial reciprocating piston rod? Any comments would be welcome on this subject or from other applications that have dramatic pressure changes.

- I have been advised that when a zinc coating is heated beyond 650 °C, the zinc becomes the cathode and the steel substrate becomes the anode. Can anyone elaborate on this for me?

- I have a client looking for protection against MDEA. He is suggesting stainless steel type 316. My research indicates that aluminum is safe in amines. Does anyone have any suggestions?

- Please list the considerations that should be taken into account when a thermal spray coating booth is designed. I was advised to consider the largest part possible that we could spray. What are the requirements now, and what might they be a few years from now? Also, when designing a dust hood, the area to be collected should be kept local to the spray area, rather than, for example, a big hole in the ceiling.

- Does anyone know were to find literature on thermal spraying polyimide and polyamide?

- What is the material density, shape, and size for polyimide powders you can spray with the HVOF system? Do you know a company that will grind batches of 50 components?

- I am interested to know whether anyone is aware of a study that looks at any changes in the spectra of the radiation produced by an arc initially struck with a gas such as argon but into which is incorporated metal vapors from the surrounding atmosphere. I am also interested in knowing about the absorption of radiation from the arc by metal vapors in the surrounding atmosphere. I am interested in calculating heat transfer from the arc to surrounding surfaces.

- We want to plasma spray polymer coatings. Can anyone suggest what brand or tradename of powder feeders can accomplish the task of spraying polymer powders 3 to 60 lb/h? Any help with this matter would be greatly appreciated.

Getting involved in this free service is easy! Send an e-mail to: majordomo @databack.com with the Message Text: "Subscribe TSS."

More details on the Thermal Spray Society and this new service, along with a new thermal spray calendar of events, can be found on the TSS Home Page at http://www.asm-intl.org/tss.

Contact: Robert A. Miller; e-mail: miller.tafa.com; TAFA Inc., 146 Pembroke Rd., Concord, NH 03301; fax: 603/225-4342; tel: 603/223-2159.

Key Tradenames Required

Frank Hermanek (Praxair) and Robert A. Miller (TAFA, Inc.) are gathering the key tradenames and other commercial names of thermal spray processes, equipment, and materials to make a commercial glossary for the Thermal Spray Society. Let Bob Miller know if you would like to suggest something. Please include what you know of the item's function, background, and corporate connections.

Contact: Robert A. Miller; e-mail: miller.tafa.com; TAFA Inc., 146 Pembroke Rd., Concord, NH 03301; fax: 603/225-4342; tel: 603/223-2159.

Thermal Spray E-Mail Discussion Group

Sharing information and networking with colleagues is one of the key tenets behind a society such as the Thermal Spray Society. To help foster this exchange of information, the Information Development and Delivery Committee of TSS has established an e-mail discussion group, known as a list server. "Internet e-mail has become a powerful communications tool since it can cheaply distribute messages around the world in a matter of seconds," said Bob Miller of TAFA Inc., chairman of the subcommittee set up to establish the list. "We look forward to a lively exchange of ideas on applications for thermal spray, coating properties, equipment for sale, positions wanted and job openings, calls for papers, and other news of interest to the community."

When people send e-mails to this net, the established courtesy is that they attach a name and address with their messages so that everyone can be aware of the type of work being carried out in various organizations.

Contact: Robert A. Miller; e-mail: miller.tafa.com; TAFA Inc., 146 Pembroke Rd., Concord, NH 03301; fax: 603/225-4342; tel: 603/223-2159.

EWI Sponsors Internet Newsgroups

Edison Welding Institute (EWI) (Columbus, OH) has created two Usenet newsgroups: sci.engl.joining.welding and sci.engr.joining.misc. Open to the public, these news groups are dedicated to discussing issues in materials joining technology. For those who do not have access to Usenet newsgroups, EWI provides a free service to receive and participate via e-mail lists. For information on how to subscribe to the mailing list, send an e-mail message to request@ewi.org with the word "info" in the subject line.

Protective Coatings Worldwide

Protective Coatings Worldwide is an online resource for the protective coatings industry. An example of the June 1997 features includes:

- "Improving Coating Processes in the Shipbuilding Industry": Steel fabrication and coating application both can be "bottlenecks" in shipbuilding, but coordination of these efforts can improve productivity.

- Regulation News: Massachusetts bill calls for lead abatement regulation.

- Network News: info on the web sites of OSHA, ASTM.

- Problem-Solving Forum: Assuring consistent lot-to-lot performance of coatings.

- News from the Field: To improve efficiency, some shipyards are partnering with contractors who establish on-site blasting and coating shops. One company shares its experience.

- What's New!: Reports on news, new products, people, and upcoming events in the industry.

Visit AMPTIAC on the Web

The AMPTIAC World Wide Web site is located at URL: http://rome.iitri.com/amptiac/.

At this time, many of the pages are still under construction. In the future, the AMPTIAC site will include complete listings of AMPTIAC products, the AMPTIAC Newsletter, all the "MaterialEASEinformation" sheets, and current news of interest to the materials community.

IIT Research Institute (IITRI), operator of AMPTIAC, is one of America's largest independent, not-for-profit contract research organizations. Established in Chicago in 1936, IITRI employs about 1100 scientists, engineers, and support staff, conducting research in virtually all of the physical and biological sciences and related technologies. IITRI undertakes about 600 research projects annually.

AMPTIAC is operated by the Engineering and Information Systems Department of IITRI, headquartered in Lanham, MD. The department works in several broad technologies: assurance technology, software engineering, manufacturing technology, environmental analysis, and genetics research. Along with AMPTIAC, the department operates two other DoD Information Analysis Centers: the Reliability Analysis Center (RAC) and the Manufacturing Technology Information Analysis Center (MTIAC). AMPTIAC and RAC are colocated in Rome, NY.

IITRI also operates two DoD Information Analysis Centers from its Applied Sciences Department, centered in Chicago, IL. These are the Guidance and Control Information Analysis Center (GACIAC) and the Defense Modeling, Simulation, and Tactical Technology Information Analysis Center (DMSTTIAC). IITRI operates several other centers of excellence, including the ADA Information Clearinghouse, the DoD Instrumented Factory for Gears, the NASA Metallurgical Research Facilities, and others.

WWW Address for Netzsch: Thermal Analysis

The Internet site for Netzsch is: http://www.netzsch.com/ta; tel: +49/9287/881-0; fax: +49/9287/881-44.

Industrial News

St. Louis Metallizing Acquires Wear Master Thermal Spray Shop

St. Louis Metallizing, a full-service thermal spray shop, recently expanded its thermal spray capacity through the strategic acquisition of Wear Master, a full-service thermal spray shop in Kenedale, TX.

Wear Master serves a variety of industries in the southwestern region of the United States, performing spray processes including combustion thermal spray, electric arc, plasma and high-velocity air fuel (HVAF). Wear Master developed and patented the HVAF process.

Turnkey service is also available through Wear Master for rebuild applications, original equipment manufacturer development, and production spray work. Wear Master's finishing capabilities include tooling, cylindrical grinding, and superfinishing.

St. Louis Metallizing, a subsidiary of Nooter Corporation, is a full-service spray and finishing shop offering a complete production facility including preparation, application, finishing, quality assurance, and technical assistance. Founded in 1934, St. Louis Metallizing is one of the largest thermal spray shops in the industry.

Contact: William H. Schawacker II, 314/421-7465 or Jane Gumersell, 314/727-4000.

Sermatech and ISPA Form Joint Venture

Sermatech Technical Services and The ISPA Company have announced the formation of a joint venture to provide high-performance fluoropolymer coatings and lining products. The joint venture, called Sermatech-ISPA, Inc., will provide coating and lining systems for equipment used in the chemical, petrochemical, pharmaceutical, food processing, and microelectronic manufacturing industries. The new venture will be located at the Sermatech facility in Sugar Land, TX, and will serve customers in the Gulf Coast Region of the United States.

The technologies to be offered by the joint venture are designed to resist corrosion, abrasion, and wear and maintain nonstick and high-purity characteristics of equipment used in acidic and caustic environments. Among the state-of-the-art products that The ISPA Company will bring to the joint venture are: Fluoroshield—a multilayer lining system that is effective in withstanding corrosion in extreme chemical environments at elevated temperatures; Blue Armor—a fluoropolymer coating that is an effective alternative to glass linings or exotic alloys for protecting processing equipment against corrosion; and MegaPure—a microsmooth seamless coating that provides a noncontaminating resistance coating for ultrapure water and chemical distribution systems.

Contact: Mike Stock; tel: 610/948-2833, Sermatech International Inc. 155 South Limerick Rd., Limerick, PA 19468. www.sermatech.com.

News from TAFA

High-Pressure HVOF Coating Performance Competes Favorably with Chrome Plating

TAFA has refined tungsten carbide and chromium carbide coatings sprayed with the JP-5000, a high-pressure, high-velocity oxygen-fuel system (HP/HVOF). These coatings not only exceed the wear resistance of chrome plate, cost less, are faster to apply and more uniform in thickness, but they also avoid the complex, costly environmental regulations surrounding the chromium plating process. A comparative study of chromium plating and HP/HVOF coatings titled, "Thermal Spray Alternatives for Electroplated Chromium" is available upon request from TAFA Inc.

Contact: Joan Rich, TAFA Inc., 146 Pembroke Rd., Concord, NH 03301; tel: 603/224-9585; fax: 603/225-4342; WWW: http://www.tafa.com.

High-Output, Anticorrosion Arc Spray System

TAFA's 8860, high-output arc spray system has completed beta-site testing on bridges in Connecticut, on structural steel in fabrication shops in Michigan and Florida, and on transmission power poles in Canada. The system sprays zinc, aluminum, and 85% Zn/15% Al alloy wires with a smooth, uniformly deposited swath, 6 to 10 in. (15 to 25 cm) wide, up to 125 lb (56 kg) per hour. The 8860 gun is rated for a maximum of 600 A and accepts both 1/8 and 3/16 in. wire sizes.

Contact: Joan Rich, TAFA Inc., 146 Pembroke Rd., Concord, NH 03301; tel: 603/224-9585; fax: 603/225-4342; WWW: http://www.tafa.com.

Superior Coatings for Anilox Rolls

The PlazJet system sprays high power plasma coatings at power levels up to 250 kW, at spray rates between 15 lb (4.5 kg) and 40 lb (23 kg) per hour. Coatings of chromium oxide, alumina-titania and alumina for anilox rolls have been developed. These coatings permit 1200 lines/in.

According to Stan Tucker of Ceramco Inc., "Advertisers are demanding greater clarity and quality from the print media. Since the anilox roll is a critical component for delivering precise, uniform amounts of ink to the printing plate cylinder, one way to improve the process is to improve the ceramic coating on the roll." Anilox rolls require dense, ceramic coatings that accept the finest microfinishing and highest density of laser engraving. Some conventional plasma sprayed coatings are too porous or too soft for high-density laser engraving. Most of the wear on the roll is caused by the doctor blade that removes excess ink. The harder the coating, the better the roll resists wear from the doctor blade.

Contact: Joan Rich, TAFA Inc., 146 Pembroke Rd., Concord, NH 03301; tel: 603/224-9585; fax: 603/225-4342; WWW: http://www.tafa.com.

Thermal Spray Coatings Extend Coal Slurry Pump Service

Pumps for coal slurries in the power-generation industry typically fail within six months, according to Larry Grimenstein of Nation Coating Systems, Franklin, OH. "The pump flanges and their bolts fail," said Grimenstein, "because the slurry is both caustic and abrasive. Our tests of several coatings proved that wear-resistant coatings alone won't do the job."

Using TAFA's 9000 arc spray system, Nation Coating Systems sprayed three coatings on three quarters of a flange while a fourth was left uncoated for comparison. The first coating was created with TAFA's 95MXC also known as Armacor Me, an arc spray wire that produces a hard, corrosion-resistant coating. The second coating was a wear-resistant, high-carbon steel. The third coating was a carbide wire for both corrosion and wear resistance.

After 15 months the pump was returned to Nation Coating Systems for evaluation. The uncoated section showed pitting and erosion of 0.005 to 0.010 in. (0.13 to 0.25 mm) around the inside diameter. None of the arc sprayed coatings showed any delamination or cracking, but the corrosion-resistant coatings performed better than the high-carbon steel. Without corrosion protection, the second coating was almost entirely worn away with most of the area looking like the uncoated portion. Both the first and third coatings showed no signs of wear or pitting. The original spray texture of the third coating was visible with no measurable wear. The coatings required no finishing before service.

Contact: Joan Rich, TAFA Inc., 146 Pembroke Rd., Concord, NH 03301; tel: 603/224-9585; fax: 603/225-4342; WWW: http://www.tafa.com.

Hydroelectric Turbine Performance Improved

Hydroelectric power producers must contend with tons of abrasive, destructive silt, and sediment annually. Thousands of Pelton wheels throughout the world, producing hydroelectric power under the most erosive conditions, are typically in service less than 60 days before replacement. In conjunction with Chilgener Inc. and Soltec S.A. of Chile, TAFA Inc. designed a coating to extend the service life of the Pelton wheel buckets. The wheels weigh 18,700 lb (8,500 kg) and have a diameter of 8.5 ft (2.6 m).

After weld repairing and grit blasting the surfaces, a tungsten carbide cobalt alloy was applied to the buckets with the JP-5000 System. Four hundred pounds (181.2 kg) of material were used in 20 h of spraying to repair the buckets. Under service conditions, considered to be the most severe in the world, the TAFA coating endured for 145 days without failure. The newly developed coating outperformed the next best coating by four times.

Contact: Joan Rich, TAFA Inc., 146 Pembroke Rd., Concord, NH 03301; tel: 603/224-9585; fax: 603/225-4342; WWW: http://www.tafa.com.

Philippine Cylinders Get the "Metallisation" Treatment

Metallisation Limited, of Dudley, West Midlands, UK, has supplied and installed equipment to a Philippines company that manufactures LPG cylinders. The Black Country manufacturer of thermal spraying equipment has provided a complete automatic metal spraying plant for Grupo F. Jacinto for applying anticorrosive coatings to the LPG cylinders they make.

The plant is being supplied to the Philippines company through German company SMG Pressen, who is supplying the LPG cylinder manufacturing line. It incorporates one of Metallisation's Arcspray 528E metal spray pistols, which can apply coatings to the 15 kg cylinders at the rate of 130 an hour. The pistol follows the cylinder's profile as the cylinder rotates about its horizontal axis, the process being carried out automatically by means of an overhead gantry scanner. The cylinders will be distributed throughout the Philippines and other Far East countries.

Contact: Metallisation Ltd., Pear Tree Lane, Dudley, West Midlands, DY2 OXH, UK; tel: +44 (01384) 252464; fax: +44 (01384) 237196.

Howmet Awarded Contract as Part of Pratt & Whitney Team

Pratt & Whitney Space & Government operations, West Palm Beach, FL, has selected Howmet Corporation to manufacture the turbine airfoil castings for the new Joint Strike Fighter (JSF) program. Howmet will manufacture single-crystal airfoils for the JSF at its facilities in Dover, NJ, and Whitehall, MI. Howmet will produce 20 sets of airfoils later this year, 10 each for the Boeing and Lockheed designs. Full production is scheduled to begin in 1998. Total production over the life of the contract has the potential of a million or more castings.

Pratt & Whitney was selected as the engine supplier for the Concept Demonstrator Aircraft (CDA) phase of the program. Howmet has worked with Pratt engineering for more than a year in anticipation of this award. Pratt received contracts in Dec 1996 and contracts for castings have recently been released.

Contact: Doreen Deary, Howmet Corp., 475 Steamboat Rd., Greenwich, CT 06836-1960; tel: 203/625-8735; fax: 203/625-8771.

Howmet Exits Refurbishment Business

Howmet Corporation has announced that it has entered into a purchase agreement with United Technologies Corporation to sell Howmet's refurbishment operations in North Haven, CT, Claremore, OK, and Wichita Falls, TX. Terms of the transaction were not disclosed. The move reflects Howmet's strategy to focus the organization's resources on its casting business.

"Orders are ramping up in both the aerospace and industrial gas turbine markets. This rebound represents a significant opportunity and, with the sale of Howmet's refurbishment operation, we can now concentrate fully on serving OEM customers and strengthening our industry position," says President and CEO David L. Squier.

Howmet's refurbishment operation, which repairs engine-run turbine components, accounts for approximately 6% of Howmet's annual sales, which exceeded $1 billion in 1996, a record for the company. Howmet and its affiliates employ 10,000 people worldwide. The corporation currently operates 26 manufacturing facilities around the world.

Contact: Doreen Deary, Howmet Corp., 475 Steamboat Rd., Greenwich, CT 06836-1960; tel: 203/625-8735; fax: 203/625-8771.

MRi Establishes New Facility

Dr. Ronald W. Smith, President, announced today that MRi (Materials Resources International) has moved its materials marketing laboratories and related offices from Blue Bell, PA, to 403 Elm Ave., North Wales, PA 19454. The 15,000 square foot facility contains corporate offices, sample processing laboratories, and limited manufacturing.

The new facility will combine staff formerly spread between facilities at Drexel University in Philadelphia and its offices in the PA region. Dr. Smith stated that locating all personnel working on similar products in one facility will improve communications, permit more rapid processing of customer samples, and accelerate market development.

Contact: Dr. Ronald W. Smith, President MRi, Materials Resources International, 403 Elm Ave., North Wales, PA 19454; tel: 215/616-0400; fax: 215/616-0496.

ASB Licensed to Build "Cold Spraying" Coating Equipment

Known as the Cold Gas dynamic Spray Method (CGSM), "cold spraying" technology has been developed and introduced to the U.S. through the sponsorship of the National Center for Manufacturing Sciences (NCMS) in Ann Arbor, MI. The CGSM method for the deposition of metallic coatings differs from conventional thermal spray methods in that the coating material is not melted prior to deposition. Coatings are deposited by exposing a substrate material to a high-velocity jet of solid-state particles, which are accelerated by a supersonic jet of gas at a temperature that is appreciably lower than the melting temperature of material particles.

Citing important environmental benefits, as well as the capability to keep the original characteristics of the powders and substrates unchanged, ASB Industries of Barberton, OH, became the first U.S. company to obtain a license to build and use the CGSM equipment. "We see it as a very promising technology," noted Albert Kay, president of ASB. Drawing a parallel between CGSM and another industry innovation: Jet Kote, Mr. Kay noted that ASB was also one of the first companies to purchase that equipment in 1982. Professor Anatolii Papyrin, who researched the CGSM technology in the former USSR, recently completed an NCMS demonstration program at the National Center for Tooling & Precision Components in Toledo, OH. "Our findings thus far," he says, "demonstrate that the technology can be used in numerous applications now employing thermal spray and that CGSM has some important advantages: high density, high-quality coatings, ecological purity, simplicity of technical implementation, high productivity, and safety of operation."

NCMS is a diversified consortium of 250 member companies that focuses on the solving of manufacturing problems through research programs funded by its members. Noted NCMS Program Manager Kerry Barnett: "Thermal spray is an area of major interest to our aerospace and automotive members, who see it as an important option in the manufacturing process. As a result, technologies such as CGSM have been selected for our NCMS-funded research programs."

New Strategy of Sulzer Medica

Sulzer is pursuing a new dual strategy that will allow greater growth opportunities in both the medical technology and industrial sectors. To meet capital needs for future acquisitions, the Sulzer Medica Group is going public, with around a fourth of the equity to be placed during the course of 1997. Significant enhancement of Sulzer's industrial sector is also planned.

Sulzer Medica, formed in 1989, is a pioneer in medical device manufacturing dating back to the first orthopedic and cardiovascular implants some 30 years ago. Along with the new strategies come new names for each of Sulzer Medica's seven companies: Sulzer Carbomedics, Inc. (previously Carbomedics, Inc.), Sulzer Intermedics, Inc. (previously Intermedics, Inc.), Sulzer Osypka GmbH (previously Osypka GmbH), Sulzer Vascutek Ltd. (previously Vascutek Ltd.), Sulzer Orthopedics, Inc. (previously Intermedics Orthopedics, Inc.), Sulzer Orthopedics Ltd. (previously Sulzer Orthopedics AG), and Sulzer Calcitek Inc. (previously Calcitek, Inc.).

Richard (Rusty) Phillips, Vice President of Research and Development for Sulzer Carbomedics, states that the pending public offering will be a tremendous opportunity for continued growth in the medical products business.

Air Products Expands Sales Agent Agreements

Air Products and Chemicals, Inc., has expanded its agreements with two U.S.-based sales agents E.T. Horn and M.F. Cachat for the company's broad line of specialty additives, marketed under the Surfynol and Dynol trademarks. Air Products' specialty additives are used in a variety of water-based applications including paints and coatings, inks, adhesives, dye manufacture and processing, paper coatings, pigment manufacture, and dispersion and latex dipping, as well as high-solids and powder coatings.

Effective immediately, E.T. Horn will be responsible for selling Air Products' surfactants, wetting agents, defoamers, pigment grind aids, dispersants, and slip and mar agents on the West Coast. M.F. Cachat will expand its current specialty additives territory of Ohio, Michigan, West Virginia, western New York, and western Pennsylvania to include Indiana, Illinois, Kentucky, and Wisconsin.

Since 1962, the E.T. Horn Co., located in La Mirada, CA, has been a manufacturer's representative and distributor of resins, pigments, plastics, specialty chemicals, food additives and ingredients, and pharmaceutical ingredients and has successfully represented Air Products' epoxy additives since 1994. With headquarters in Cleveland, OH, the M.F. Cachat Company is a manufacturer's representative and distributor for the plastics, rubber, and coatings industry since 1977 and has successfully represented Air Products' specialty additives since 1984.

Contact: Katie Zamolyi, Air Products and Chemicals, Inc., 7201 Hamilton Blvd., Allentown, PA 18195-1501. Tel: 610/481-6724.

Federal Court Finds For Pratt & Whitney against Chromalloy

A U.S. District Court judge in Delaware has found that Chromalloy, a unit of Sequa Corporation, had violated its license agreement with Pratt & Whitney by failing to pay license fees to the jet engine builder. As a result of this finding, Chromalloy has agreed to pay the back royalties it owes with interest. The final sum is expected to be several million dollars.

The finding comes as part of an extensive breach of contract legal action filed by Pratt & Whitney, a United Technologies Company, against Chromalloy. The remaining issues of the action are anticipated to be tried later this year in federal court in Delaware.

The royalties at issue covered Chromalloy's use of proprietary Pratt & Whitney ceramic coatings for jet engine airfoils and other patented Pratt & Whitney processes. The Delaware action is related to the recent Texas state court antitrust case in which the jury rejected Chromalloy's claim that it had suffered monetary damage because of Pratt & Whitney's alleged monopolization of the jet engine repair business. The jury also ruled that Chromalloy had engaged in unfair competition, misappropriation of Pratt & Whitney data and drawings, and fraudulent concealment. The Texas court recently ruled that Chromalloy could not collect any damages from Pratt & Whitney or get an injunction.

Contact: Mark Sullivan, Pratt & Whitney, 400 Main St., East Hartford, CT 06108; tel: 860/565-4415; WWW: http:/www.pratt-whitney.com.

New Powder Metallurgy Consultants Directory Issued

A new listing of experienced consultants in powder metallurgy, metal injection molding, and advanced particulate materials has been published by the Metal Powder Industries Federation. The four-page directory covers North American and international consultants specializing in testing, design, applied research, market research, training, plant design, quality systems, and product evaluation. Their expertise covers metal powders and materials, conventional P/M processing, powder injection molding, hot isostatic pressing, spray forming, brazing technology, and prototype design and manufacture.

Contact: Peter K. Johnson, Metal Powder Industries Federation, 105 College Rd., East Princeton, NJ 08540-6692; tel: 609/452-7700; fax: 609/987-8523; WWW: http://www.mpif.org/mpif.

News from NASA

Simpler Combustion Chamber, Nozzle, and Fabrication Process

A simplified design for the combustion chamber and nozzle of a rocket engine has been proposed to reduce the time and cost of fabrication. A conventional combustion chamber/nozzle assembly of the type to be replaced operates with active cooling; for this purpose, it must contain integral cooling passages fed by manifolds. The fabrication of such a complex object in one integral piece involves processing of numerous piece parts through numerous steps of machining, plating, welding, and brazing, leading to long fabrication time and high cost. The proposed combustion-chamber/nozzle assembly would not be actively cooled, so that there would be no need for cooling passages, and fabrication would be simplified and accelerated accordingly.

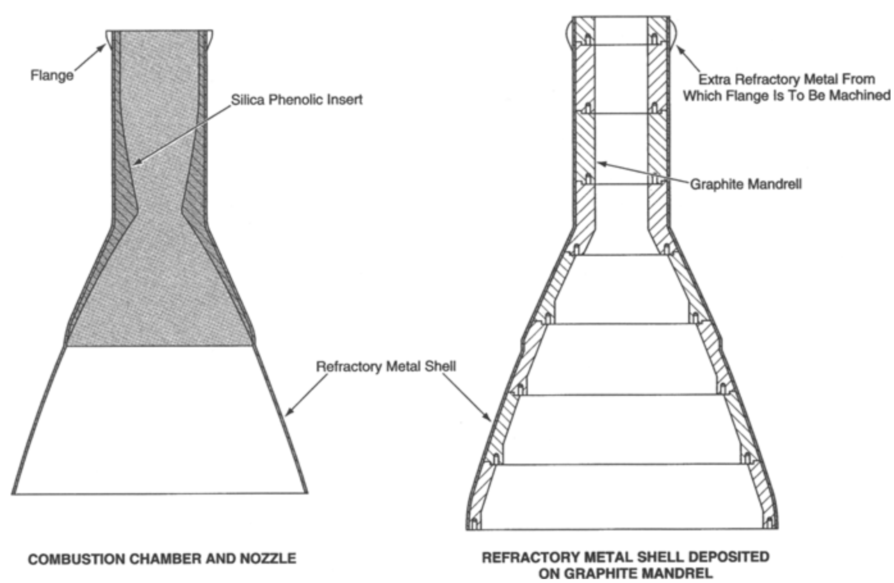


Fig. 1 The combustion chamber and nozzle would be made in only two pieces: a refractory metal shell with a silica phenolic insert bonded inside.

The proposed combustion chamber and nozzle (see Fig. 1) would include a shell of refractory metal (e.g., a niobium-base alloy). An integral flange would be formed at the upper end of the shell. To provide some thermal protection and a barrier against oxidation, the inner surface of the shell would be coated with aluminum oxide or other suitable material. In the combustion chamber region, the shell would be further lined with an ablative silica phenolic insert. During operation, resins would boil off from the phenolic, leaving behind a char layer that would, along with a remaining phenolic, protect the refractory-metal shell against overheating. The thickness of the insert would be chosen so that the char would not penetrate too deeply during the design operating life. Inasmuch as the operating temperature would decrease toward the exit (lower) end of the nozzle, the thickness of the insert would be made to taper down to the point where the coated refractory metal could survive without further protection.

The shell would be fabricated by vacuum plasma spraying (VPS) on a graphite mandrel. Optionally, one could first apply the aluminum oxide or other thermal/oxidation-barrier layer to the mandrel by either a traditional coating technique or VPS. If this option were selected, then VPS would be started initially with the thermal/oxidation-barrier material, then making a gradual transition to the refractory alloy, then continuing with the alloy to obtain the required thickness. The other option would be to deposit only the alloy by VPS, then coat the inner surface of the shell with a silicide after completion of deposition and removal of the shell from the mandrel. The alloy would be deposited to extra thickness at the upper end; the thickened upper end would then be machined to make the flange. Because of a large difference between the coefficients of thermal expansion of graphite and the refractory alloy, the shell could be easily removed from the mandrel once it had cooled from the VPS temperature.

The ablative insert would be made from silica phenolic tape wrapped on a steel mandrel, which would be configured to obtain approximately the contour of the interior of the combustion chamber. While still on the mandrel, the wrapped tape would be cured, then machined to make an insert to match precisely the contour of the combustion chamber. The insert would then be removed from the mandrel and bonded into the combustion chamber.

This work was done by Charles S. Cornelius and Neill Myers of Marshall Space Flight Center. Extracted from *NASA Tech Briefs*, Vol 21 (No. 4), 1997, p 68-69.

VPS Fabrication of Ceramic/Metal Furnace Cartridges

A vacuum plasma spray (VPS) process has been developed for making thin-walled ceramic/refractory metal composite furnace cartridges. These cartridges are used to contain and heat quartz ampoules that contain semiconductor materials for processing. The cartridges are required to resist chemical attack by the molten semiconductors in order to provide secondary containment should the quartz ampoules leak. The use of ceramic/refractory metal composites for this application makes it possible to utilize the corrosion resistance of the ceramics and the ductility and toughness of the metals, yielding robust cartridges that can withstand high temperatures and the stresses of fabrication and service.

In this process, a furnace cartridge is formed by VPS on a net-size-and-shape

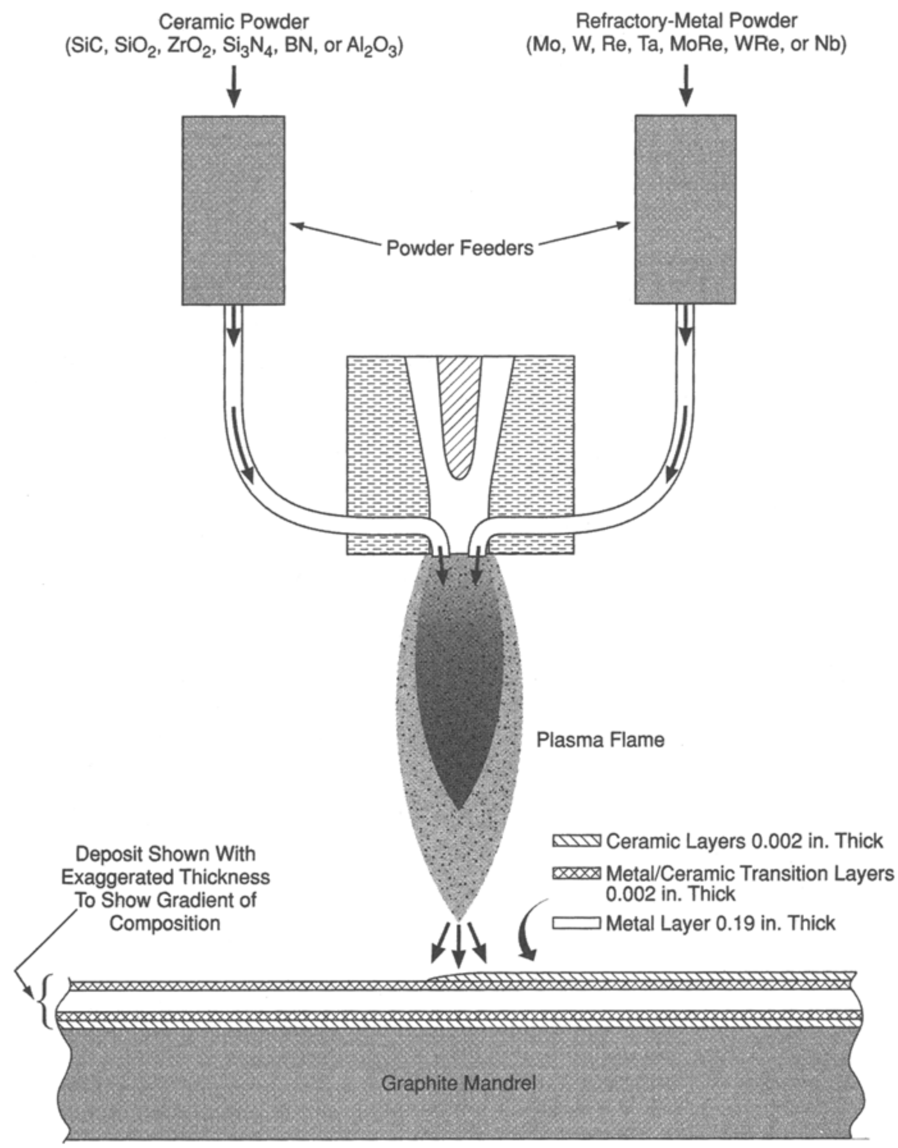


Fig. 2 Ceramic and refractory metal powders are injected into the plasma flame in variable proportions to deposit a graded-composition ceramic/metal composite on the mandrel.

graphite mandrel, to which the deposited ceramic/metal composite material does not adhere. Upon cooling to ambient temperature after VPS, the mandrel shrinks at a greater rate than the deposited material due to its higher thermal coefficient of expansion, so that the deposit becomes the desired free-standing tube and can be slipped off the mandrel. Mandrels of this type were described in Removable Mandrels for Vacuum-Plasma Spray Forming (MFS-30005), *NASA Tech Briefs,* Vol 19 (No. 5), May 1995, p 82.

In this VPS process (see Fig. 2), refractory metal and ceramic powders are injected into a gun that generates a plasma flame by ionization of gases in a DC arc. The plasma flame melts the powders and accelerates the molten materials, depositing them on the mandrel. The process includes the use of a controlled-powder-feeding technique that enables the formation of a deposit with a gradient of ceramic/metal composition to obtain a desired combination of thermal, mechanical, and chemical properties. For example, one experimental tube comprised an inner layer of ceramic, followed by a transition layer of half metal/half ceramic, followed by a layer of metal, followed by another metal/ceramic transition layer, followed by an outer ceramic layer.

The process also involves robotic manipulation of the VPS gun and the graphite mandrel; this makes it possible to complete the deposition of an entire furnace cartridge tube in one operation. Typically, as the VPS gun and mandrel are manipulated, the VPS gun is kept aimed perpendicularly to the surface of the mandrel to obtain the greatest density of deposition. Before deposition, the mandrel is preheated by operating the gun without the powder feed. Before and during deposition, the loss of heat from the mandrel is minimized by use of metal reflectors to reflect thermal radiation back into the mandrel.

This work was done by Phillip D. Krotz, Douglas M. Todd, William M. Davis, Timothy N. McKechnie, Christopher A. Power, William H. Woodford, and Yoon K. Liaw of Rockwell International Corporation and Richard R. Holmes, Frank R. Zimmerman, and Richard M. Poorman for Marshall Space Flight Center. Extracted from *NASA Tech Briefs,* Vol 21 (No. 4), 1997, p 69-70.

Ultrasonic Instrument Produces Thickness-Independent Velocity Images

A weakness of conventional C-scan imaging regarding both peak amplitude and time-of-flight modes is that gray or color scale variations in images for back-surface reflections indicate part-thickness variations, as well as microstructural variations, unless the part is uniformly thick. A single transducer ultrasonic imaging method based on ultrasonic velocity measurement is described here that eliminates the effect of plate-thickness variation in the image, that is, the method is thickness independent. The method thus isolates ultrasonic variations due to material microstructure.

The present imaging subsystem is incorporated into a conventional ultrasonic C-scan apparatus with a single ultrasonic transducer and a computer with conventional ultrasonic-signal-processing software plus special software to implement the subsystem computations. The apparatus is set up for pulse/echo measurements of the velocity of sound in a tank of water. The transducer is mounted in the water on a scanning mechanism above the specimen. Below the specimen is a plate for reflecting ultrasound. At each scan position, the ultrasonic echoes from the surfaces of the specimen and the plate are analyzed to determine the speed of sound in the specimen material.

The subsystem is expected to find use in numerous applications in which there is a need for nondestructive detection of flaws in structural parts and nondestructive evaluation of spatially varying properties of materials. In the case of advanced ceramic materials undergoing development in the aerospace and automotive industries, gradients of density, porosity, and chemical composition are properties that are of particular interest and that affect the speed of sound. The data generated by the ultrasonic apparatus equipped with this subsystem quantify such gradients about 10 times better than do the data generated by the same apparatus operating in the traditional peak-echo-amplitude or relative-echo-time (time-of-flight) mode.

Figure 3 illustrates the superior capability of this subsystem for revealing gradients of density in a specimen of a ceramic material that is under consideration to replace metal parts in automobiles. The specimen is 0.3 mm thicker at the top of the figure than at the bottom and varies smoothly from top to bottom. The specimen contains distinct regions of low (95% of theoretical), average (98% of theoretical), and high (100% of theoretical) density. The image in the left part of the figure was generated in an ultrasonic C-scan in a conventional time-of-flight mode; this image indi-

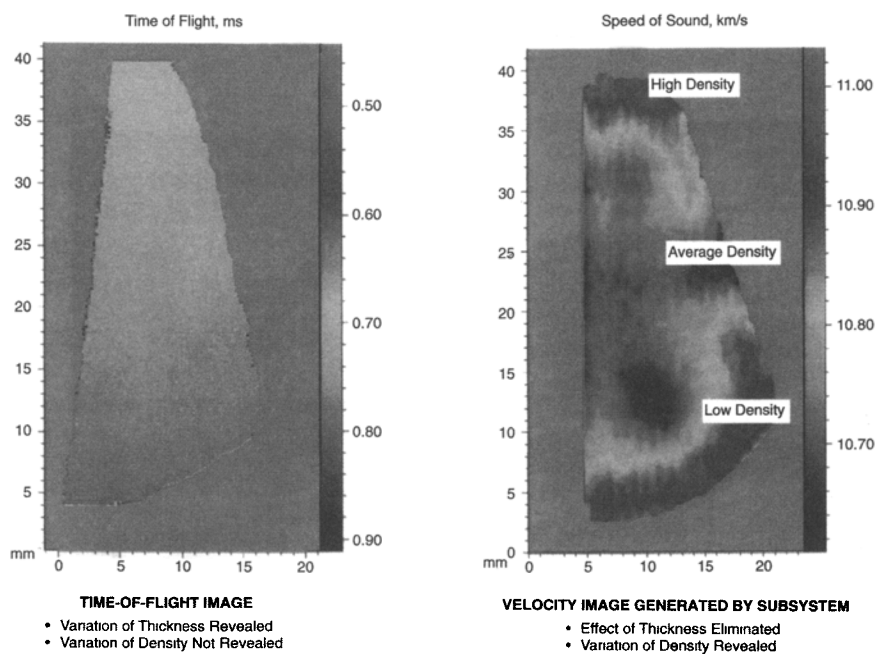


Fig. 3 Gradients of density are indicated in the velocity image generated by the subsystem described in the text, whereas only the variation of thickness is depicted in the time-of-flight image.

cates the variation in thickness from top to bottom, but gives no indication of the variation in density. The image in the right part of the figure, generated by scanning the specimen while using the present subsystem, clearly reveals the variation in density, without the effect of thickness.

This work was done by Don J. Roth of Lewis Research Center, Mike F. Whalen and J. Lynne Hendricks of Sonix, Inc., and John H. Hemann and James R. Bodis of Cleveland State University.

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Lewis Research Center, Commercial Technology Office, Attn.: James Martz, Mail Stop 7-3, 21000 Brookpark Rd., Cleveland, OH 44135. Refer to LEW-16257. Extracted from *NASA Tech Briefs,* Vol 21 (No. 4), 1997, p 31-32.

Full-Flow-Field-Tracking Particle-Image Velocimetry

Full-flow-field-tracking (FFFT) particle-image velocimetry (PIV) is a technique for obtaining quantitative and qualitative data on flows from sequences of images of small seed particles entrained in the flows. FFFT PIV is closely related to other velocimetric methods, described in several previous articles in *NASA Tech Briefs,* that are also denoted by "PIV" and by similar names like "particle-tracking velocimetry" (PTV) and "particle-displacement tracking" (PDT).

Figure 4 schematically illustrates a flow experiment conducted with a FFFT PIV apparatus, which is similar to the apparatuses used in the other techniques mentioned above. Illumination is supplied by a continuous-wave argon-ion laser with a power of 8 W. An assembly of cylindrical lenses forms the laser beam into a sheet of light to illuminate a plane of interest in the test section of a wind tunnel, water tunnel, oil tunnel, or other flow apparatus.

The flow is seeded with highly reflective particles with sizes up to about 10 μm. For studying flows of water or oil, a suitable particle material is MgO_2, which is nearly neutrally buoyant in those liquids. For studying flows of air, the selection of particle materials is more problematic; care must be taken to eliminate spurious particle motions (e.g., bouncing off surfaces of objects) in specific experimental regimes.

A low-luminosity charge-coupled-device video camera with a resolution of 756 horizontal pixels by 581 vertical pixels is focused on the illuminated plane. The camera is equipped with long-distance-microscope optics that can magnify a selected portion of the plane by a factor as large as 100 to reveal details of the flow field. The output of the camera can be either digitized and stored directly in a computer memory or else recorded on videotape and subsequently digitized for processing by the computer.

The camera operates at a frame rate of 30 Hz; this frame rate is adequate as long as the flow under observation is not so fast that images of particles become continuous streaks across the field of view. To provide stroboscopy for viewing such rapid flows, the optical system includes a rotating laser beam-chopping

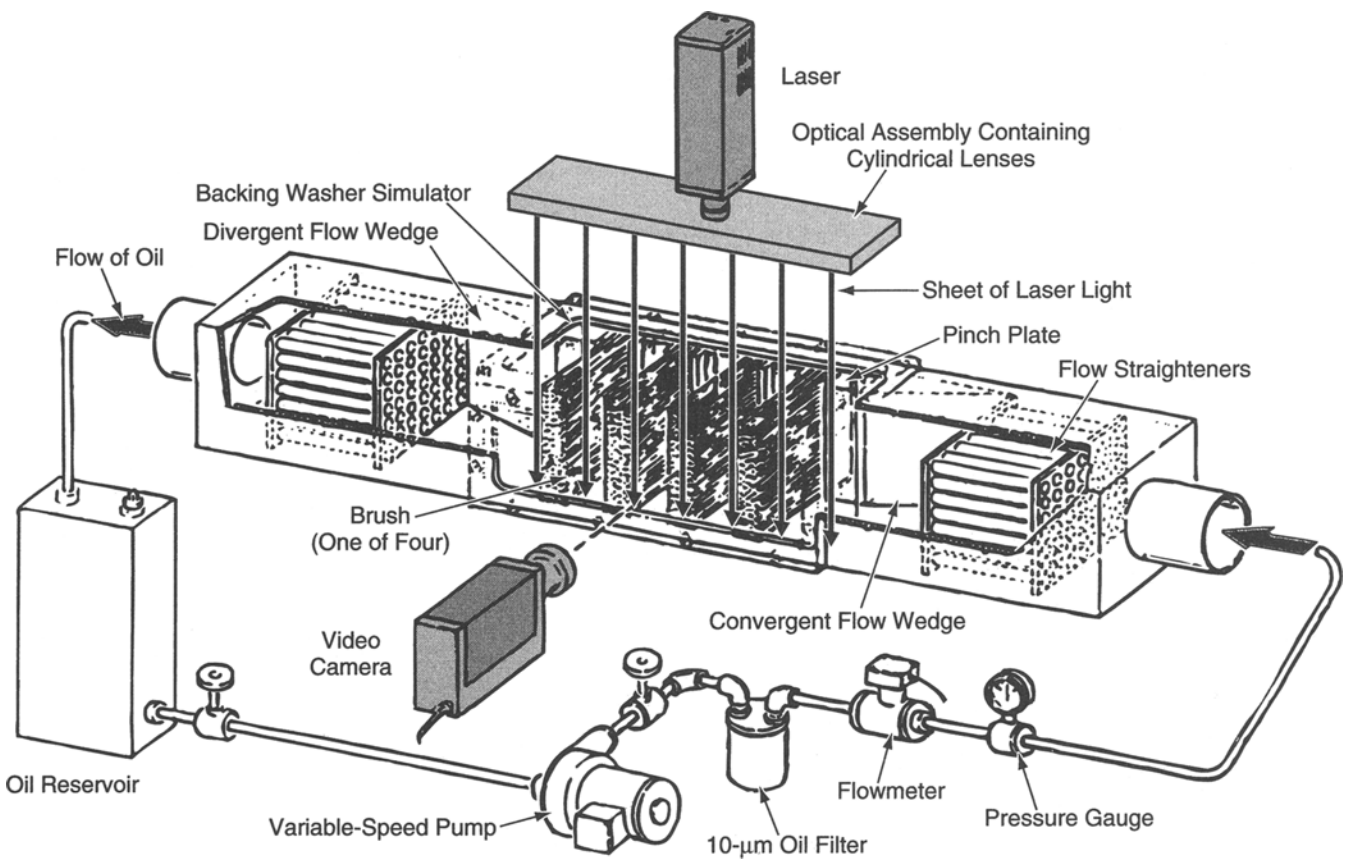


Fig. 4 An oil tunnel is instrumented with an FFFT PIV apparatus to study flows through brushes that represent brush seals in turbomachines. The FFFT PIV apparatus has also been used to study flows of water past cylinders, airfoils, and other objects, and flows of air past an array of pins in staggered rows.

disk. The speed of rotation can be chosen to obtain strobing frequencies at integer multiples of 30 Hz, up to a maximum of several kilohertz.

Sequences of images are processed by a computer integrated image quantification (CIIQ) method, which is a partly manual, partly automated method for identifying images of individual particles and tracing their motions across the flow field during a chosen observation interval. The CIIQ method involves three computer programs called "FACT," "SNAP," and "VADT." Using calibration images obtained by focusing the video camera on graph paper, FACT generates magnification factors for the recorded images. Then by use of a digitizing puck (similar to a mouse) and pad along with SNAP, a technician visually identifies and digitizes the position of each particle of interest in the succession of strobe or frame intervals that, collectively, constitute the observation interval. The technician continues this process until the digitized particle trajectories are sufficiently numerous to represent the flow field to the desired level of detail.

The digitized trajectory data are fed to VADT, which fits the sequence of positions of each particle to a polynomial (up to ninth order) function of time. Velocities and accelerations are computed as the first and second derivatives, respectively, of the polynomials. The resulting velocity and acceleration data from the magnified small areas of the plane of interest are then computationally assembled to obtain a representation of the flow field throughout the plane.

This work was done by Victor A. Canacci and M. Jack Braun of the University of Akron for Lewis Research Center. Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Lewis Research Center, Commercial Technology Office, Attn.: Tech Brief Patent Status, Mail Stop 7-3, 21000 Brookpark Rd., Cleveland, OH 44135. Refer to LEW-16309. Extracted from *NASA Tech Briefs*, Vol 21 (No. 6), 1997, p 32-34.

Protective Coatings for Gamma Titanium Aluminides

Coating alloys of general composition Ti/Al/*X* (where *X* denotes Cr, Fe, or another suitable metal) have been developed recently to protect gamma titanium aluminide (γ-TiAl)-base alloys. At half the density of superalloys, γ-TiAl-base alloys are promising candidate materials for use at temperatures between 600 and 850 °C in turbine engines. Replacement of superalloys by γ-TiAl-base alloys would increase thrust-to-weight ratios in the engines and reduce the costs of operating them. However, protective coatings are needed because bare γ-TiAl-base alloys do not resist oxidation adequately and are potentially susceptible to embrittlement by oxygen and nitrogen; this is especially true at temperatures above 750 to 850 °C.

Aluminizing treatments, conventional *M*CrAlY (*M* = Ni or Fe) coating alloys, and ceramic coatings for γ-TiAl-base alloys have not proven successful because of poor mechanical properties, mismatch of thermal expansion coefficients, or chemical incompatibility. Promising coating alloys have previously been identified in the Ti/Al/Cr system; these alloys exhibit excellent resistance to oxidation and are generally compatible with the γ substrate alloys. However, prior to the development of the present Ti/Al/Cr alloy, the alloys in this system had been found to be extremely brittle.

A Ti/Cr/Al coating alloy developed at NASA Lewis exhibits excellent compatibility with substrates and some improvement in mechanical properties, without sacrifice of resistance to oxidation. The alloy composition, Ti/51.25Al/12.25Cr (the numbers indicate atomic percentages), was selected so that the microstructure consists of the γ phase with a minor volume of the oxidation-resistant Laves phase $Ti(Cr,Al)_2$. By basing the coating alloy on the γ phase, one optimizes mechanical properties and compatibility with γ substrates. The volume fraction of the Laves phase is kept to a minimum because it is extremely brittle.

The Ti/51.25Al/12.25Cr coating alloy was applied to a substrate of the γ alloy Ti/48Al/2Cr/2Nb by low-pressure plasma spraying. Oxidation tests at temperatures of 800 and 1000 °C in air indicated that the coating alloy successfully protected the substrate from oxidation (see Fig. 5). Evaluation of the isothermal fatigue behavior of the coated substrate at high temperatures in air is in progress.

The fundamental studies that led to the development of the Ti/51.25Al/12.25Cr alloy also provided a basis for the selection of new oxidation-resistant Ti/Al/*X* alloys. One such alloy is Ti/53Al/11Fe. This alloy is potentially useful as a reaction barrier between conventional FeCrAlY oxidation-resistant coatings and γ-TiAl-base substrates. FeCrAlY coatings are not chemically compatible with titanium aluminides and form brittle reaction products. The Ti/53Al/11Fe alloy would be an excellent reaction barrier because its Fe content is intermediate between the Fe contents of the coating and substrate, and because it resists oxidation.

This work was done by Michael P. Brady of the National Research Council and

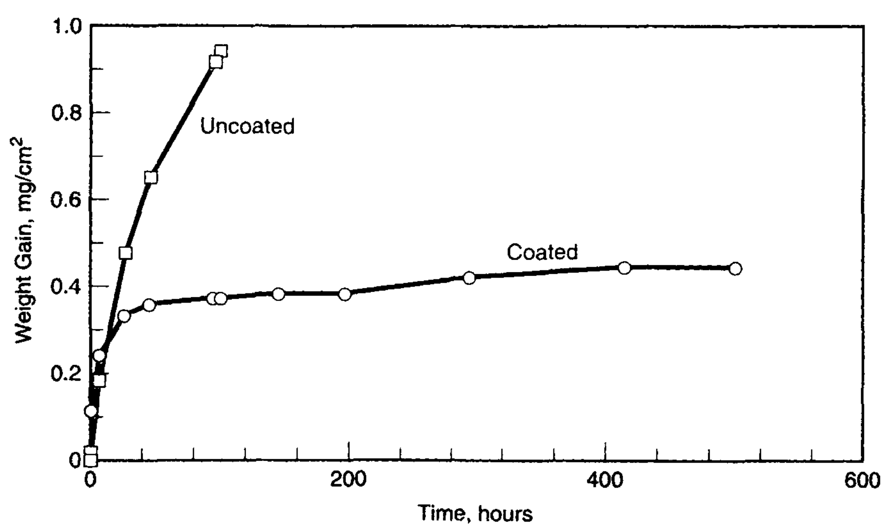


Fig. 5 These plots of weight gains show data from an experiment on uncoated and Ti/51.25Al/12.25Cr-coated Ti/48Al/2Cr/2Nb substrates in air at a temperature of 800 °C in a furnace. At each data point, the specimen was cooled in air to room temperature, weighed, and returned to the furnace. The data indicate that the coating protected the substrate from oxidation.

James L. Smialek and William J. Brindley of Lewis Research Center. Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Lewis Research Center, Commercial Technology Office, Attn.: Tech Brief Patent Status, Mail Stop 7-3, 21000 Brookpark Rd., Cleveland, OH 44135. Refer to LEW-20003.

News from NIST

Neutrons Tackle Materials Stress

Too much stress in materials can cause them to crack; yet some mechanical stress is unavoidable in materials. One of the goals of materials researchers is to find ways to both reliably measure stress and to predict what stress levels will cause metal or ceramic parts to fail. This work is particularly important for pipelines, support beams, railroad rails, or other critical applications where a materials failure could cause lost lives.

NIST researchers recently completed construction of an instrument at the NIST research reactor that gives materials scientists an atomic-level view of mechanical stress in metal and ceramic parts. The double-axis diffractometer for residual stress, or DARTS, performs stress measurements about five times faster than an earlier instrument. DARTS uses neutrons from the reactor as probes to help find variations in the spacing of atoms in crystalline materials. NIST researchers expect that an important result of this research will be development of a Reference Standard for testing and calibrating portable x-ray and ultrasonic instruments, which could then be used in the field to measure stress in airframes, railroad rails, or pipelines.

Contact: Paul Brand; tel: 301/975-5072. Extracted from *Technology at a Glance,* Spring 1997.

Excerpts from *EPRI Journal*

The Electric Power Research Institute, P.O. Box 10412, Palo Alto, CA 94303.

Solutions for Steam Generators

Problems with steam generators have been a major source of forced outages and capacity factor loss in pressurized water reactors. Over the years, the leading forms of degradation affecting steam generators have changed: as scientists and engineers have discovered the causes and cures for one set of problems, other problems have arisen. All in all, much progress has been achieved. Replacement steam generators with improved materials and design features have experienced only minimal damage, and a developmental tube repair technique based on laser welding has the potential to reduce maintenance costs significantly. Some degradation mechanisms, however, have not yet been controlled and threaten to limit the useful life of many steam generators unless ongoing research discovers ways to manage them. (John Douglas, *EPRI Journal,* Vol 20 (No. 3), May/June 1995, p 28-34)

Clean and Superclean Steels for Turbines

Impurity levels strongly influence the fracture toughness of steam turbine materials and thus their performance and reliability. Since the mid-1970s, EPRI has been sponsoring R&D to manufacture and evaluate clean and superclean steels—steels with reduced impurity levels—or turbine rotor applications. This work is beginning to come to fruition: improved fracture toughness characteristics have been conclusively demonstrated; in Japan, Europe, and the United States, components constructed of steels manufactured to EPRI guidelines have been installed to increase steam turbine reliability, cycling ability, and efficiency while lowering operating and maintenance costs. Current R&D activities focus on increasing the use of emerging clean and superclean materials for steam turbine rotors and on establishing the suitability of these materials for new applications, such as combustion turbine disks. (Vis Viswanathan, *EPRI Journal,* Vol 21 (No. 1), Jan/Feb 1996, p 40-42)

High Value for Condition Assessment

Assessing the condition and remaining life of high-temperature power plant components can help a utility optimize inspection and maintenance schedules, make replacement decisions, and avoid premature equipment failure. Recent advances in this field make it possible to operate some power plants well beyond their design life, with tremendous potential savings. The first step in conducting life assessment is to determine the present condition of a component. EPRI has championed a three-level approach to this task: calculations to screen for potential damage, nondestructive evaluation to detect degradation and cracks, and refined analysis based on destructive testing. In thin-section components, rupture results from uniform, bulk damage. In heavy-section components, on the other hand, failure results from cracking in localized regions of stress concentration. For components that are brittle and either highly stressed or subject to high-cycle fatigue, crack initiation essentially signals the end of life. However, for components that are stationary or made from highly ductile steels, crack propagation can be tolerated up to some critical level, and periodic inspections can help keep the component in service. Research on advanced methods for assessing material condition nondestructively and more accurately is continuing. (John Douglas, *EPRI Journal,* Vol 21 (No. 5), Sept/Oct 1996, p 26-34)

Excerpts from *Structure,* Struers Journal of Materialography

Struers Division Radiometer America Inc., 810 Sharon Dr., Westlake, OH 44145; tel: 216/871-0071; fax: 216/871-8188.

Problems Relating to the Metallographic Preparation of γ-TiAl-Base Alloys

So far, preparation results have indicated that producing the perfect structure in γ-TiAl-base alloys, for both optical and scanning electron microscope examination, is fraught with difficulties. Both electrolytic and mechanical polishing can cause preparation defects that falsify the true microstructural features. It is demonstrated that by selecting the optimal influencing parameters, especially in the mechanical polishing stage, good reproducible structures can be achieved, independent of heat treatment and microstructural conditions.

The aim of this work is to achieve a reproducible improvement in preparation quality of intermetallic γ-TiAl-base alloys. The main emphasis was put on the optimization of polishing because this preparation step directly influences the development of defect-free microstructures.

Mechanical and electrolytic polishing were applied and the controlling parameters varied. The best results from all the experiments were obtained using a method, derived from the steps of a Metalog Guide method, using a perfect and concentrated OP-S suspension, to which hydrogen peroxide and ammonium was added. This method is already used for routine applications.

Electrolytic polishing can also yield good results, provided that all parameters are adjusted according to the size of the sample. Mechanical polishing in general provides a quality level that cannot be reached by the equipment used for electrolytic polishing. (W. Glatz, B. Retter, A. Leonhard, and H. Clemens, *Structure,* Vol 29, 1996, p 3-7)

Universal Metallographic Procedure for Thermal Spray Coatings

Metallographic specimen preparation of thermal spray coatings is continuing to undergo intense scrutiny. From ASM to ASTM, efforts are being mounted to provide laboratories with metallographic procedures that produce accurate microstructures. The initial difficulties encountered by both groups were primarily related to identification of the true structure of coatings. As this issue is resolved, the secondary task of how to reveal the true structure on a consistent basis becomes crucial.

The introduction of new machinery and consumable products into laboratories has transformed the "art" of metallography into a controllable process. A secondary, and perhaps, more profound effect of this shift has been the simplification of those processes. Yesterday's methods were often composed of a multitude of steps. Additionally, these methods were coating specific; that is, a different method was needed for each coating system. Notable progress has been made toward a more "universal" method. In addition to being applicable to a wide range of coatings, this method is quite simple. The results of this new method will be presented as applied to a wide range of thermal spray coatings and other wrought and cast materials. Metallographic specimen preparation is a valuable tool for the characterization of thermally sprayed coatings. There are many methods presently being used to prepare coatings for microstructural evaluation. Most metallographers have their own "magic" method for producing what they call the proper microstructure.

There is the need to eliminate the "art" of metallography and replace it with the "science" of metallography. This transformation requires the level of control and repeatability that only automation can give. In the course of automating the process, it can also be simplified. (S.D. Glancy, *Structure,* Vol 29, 1996, p 12-16)

Excerpted from *Ceramic Industry*

Ceramic Industry, 5900 Harper Rd., Solon, OH 44139-1835; tel: 216/498-9214; fax: 216/ 498-9121.

Fluidized Bed Jet Milling for Economical Powder Processing

Fluidized bed jet mills offer reduced manufacturing costs, product purity, and quality to processors of rare earths and ceramic powders. Abrasive ceramic powders used in manufacturing components for metal cutting, metal forming, mining, drilling, and the production of wear parts have replaced metal in many areas due to their thermal stability, corrosion resistance, hardness, and durability. In electronic applications, their low electrical conductivity is an advantage.

Similarly, the demand for rare earth compounds, such as samarium cobalt and neodymium iron, is increasing for the manufacture of permanent magnets. These compounds permit the production of magnets with higher magnetic energy potential than conventional ferrite magnets. In both cases, these powders must be subjected to size reduction and classification to achieve a steep particle size distribution (PSD). The powder produced must be easily sinterable, free of contamination and provide strongly reactive surfaces.

Fluidized bed jet mills can be used for any material that can be fluidized by the expanded compressed air in the grinding chamber. Some common applications include: nonoxide ceramics such as silicon carbide, silicon nitride, and boron carbide; oxide ceramics such as zirconium oxide, aluminum oxide, and magnesium dioxide; rare earth magnet raw material such as samarium cobalt and neodymium iron boron, where processing in inert gas is required. (S.J. Miranda and L.J. Burghart, *Ceramic Industry,* Vol 146 (No. 4), April 1996, p 88-96)

From Sieves to Lasers: Advances in Particle Size Analyzers

A good understanding of particle size and particle size analysis is crucial in order to meet the high-quality needs of modern ceramic manufacturing. In the area of slip casting, particle size can affect castability of the suspension, theological properties, casting rate constant, porosity, and texture of the green bodies. Particle size also has an effect on sintering, which impacts final properties such as density and magnetic susceptibility. (S. Wible, *Ceramic Industry,* Vol 146 (No. 7), July 1996, p 47-48)

Considerations of Light Scattering Particle Size Measurement

Use of light scattering to measure the size and size distribution of particulates has been in commercial use for nearly 25 years. Studies of the particle size of ceramics include coarse particulates greater than submicron using diffraction techniques. Of more recent interest are the nanometer ceramic studies being conducted at Clarkson University and elsewhere using the Microtrac Ultrafine Particle Analyzer. Aside from the basic principles of the measurement technique, many other factors may influence the reported data. Concepts such as circulation of dry powder or slurry particulate, refractive index effects and comparison to other methodologies can have great impact on the measurement.

Since inception of the use of light scattering as a particle size measuring tool, it has become accepted that the data may not adhere to values associated with other particle size methods. Because each method relies on a particular theory and implementation of the theory, agreement between the data from the different methods may not occur.

However, it has been shown that data relations exist between the methods that allow cross-referencing, which is commonly termed correlation. While it is desirable to have the methods agree, the effects of shape and technical design can preclude this end. As a result a statistical approach (usually linear regression) has been used extensively to allow implementation of newer technologies, which may provide values different from previously used techniques. (P.E. Plantz, *Ceramic Industry,* Vol 146 (No. 7), July 1996, p 30-32)

The "Job Shop" Forum

By Elliott R. Sampson, TAFA, Concord, NH.

The June issue promised high-velocity oxygen fuel (HVOF) as the topic for this issue. Supersonic, hypersonic, and finally, hypervelocity oxyfuel have been used to describe this relative newcomer to the thermal spray job shops. Models have been or are called under the tradenames of Jet Kote, Diamond Jet, J-Gun, JP-5000, Aerospray, Top Gun, 2000, CDS, and others. They started to appear in job shops in the late 1970s and are now in a majority of shops applying carbides today.

These shops serve the oil and gas industry—both the production and refinery divisions of the industry. In order to present a complete picture of job shops using HVOF equipment for this industry, several shops in Edmonton, Alberta, Canada, and Houston, TX, were visited and those applicators were interviewed. The companies represented are Fusion, F.W. Gartner, and Quality Hard Chrome. The shops do work for refineries, but Fusion has specialized in crankshafts (Fig. 6). They have shut down their chrome plating lines and are converting to HVOF using 75/25 chromium carbide nickel chrome because of the high bond strength and ductility of the coating to handle the bending in service of the part. Stratton Gillis, president of Fusion, stated that the cost of HVOF is competitive to the chrome plate price of $3.50 per square in. All of the shops interviewed agree that thermal spray alternative to chrome plating, especially large parts or those with complex geometries, is a very cost-effective method.

Other applications at Fusion are chemical plant centrifugal compressor rotors, repair of bearing seal areas, coupling fits, and thrust bearing fits. Figure 7 shows a compressor rotor bearing area being sprayed with the 83-17 tungsten carbide cobalt.

Jimmy Walker, Jr., of F.W. Gartner prefers a combination of shop and on-site application work. Their shop work includes some of the same work as Fusion, but their shop specialties are ball valves and gas turbine applications. Other applications are coupling fits. Customers specify a range of materials, but alloy 718 is preferred because it is fast, thick, and easy to machine. Gartner also sprays natural gas compressor rods with tung-

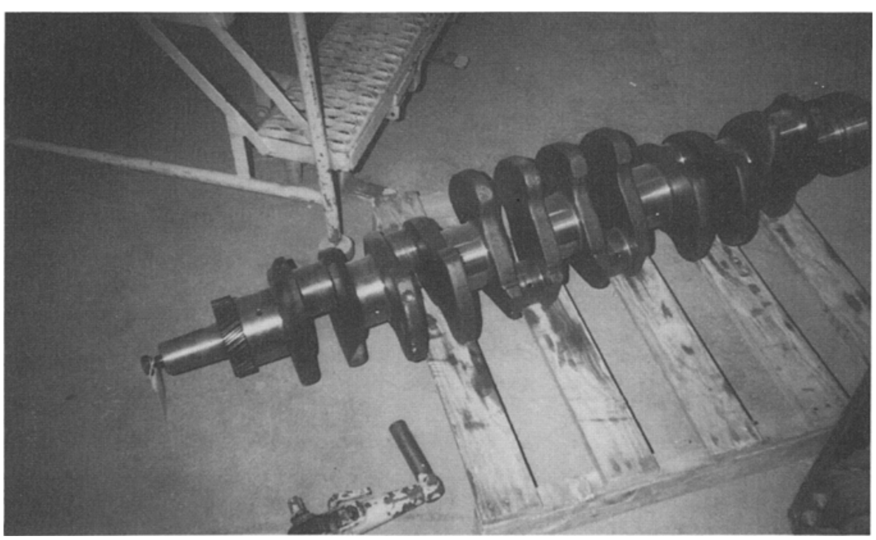


Fig. 6 Crankshaft ready for spraying

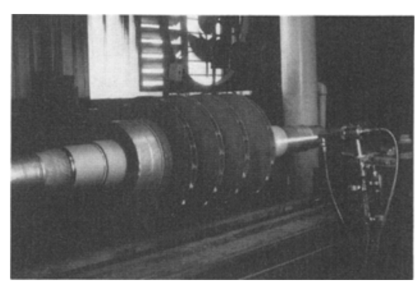


Fig. 7 Centrifugal compressor rotor

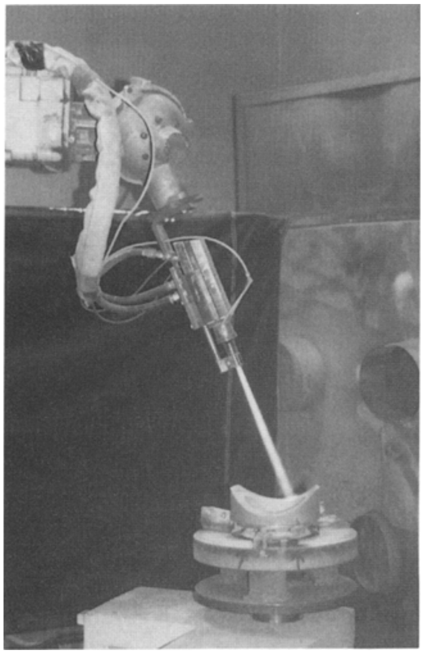


Fig. 8 HP/HVOF spraying tungsten carbide 83-17

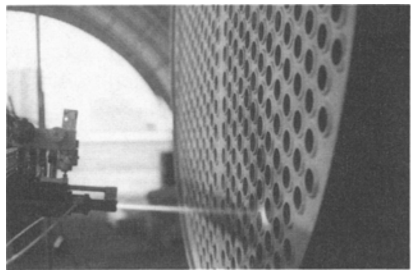


Fig. 9 Heat exchanger tube sheet

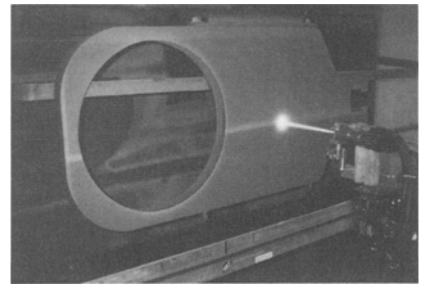


Fig. 10 Gate valve

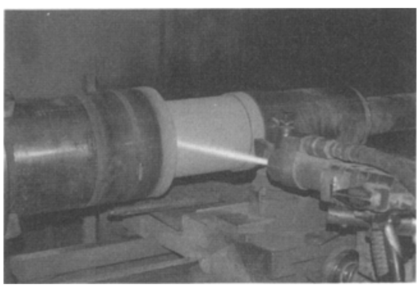


Fig. 11 HVOF spraying of bearing mandrel for downhole motor

Fig. 12 Bearing mandrels waiting for the finishing operation

Fig. 13 Finished bearing mandrels

sten carbide 83-17, and 86-10-4 is often selected for corrosion applications. (88-12 is too hard to withstand flexing.) Power plant steam fits such as coupling, thrust, Babbitt bearing, radial bearing, and carbon seal fits are other applications that are HVOF sprayed. A gas processing plug valve seal is shown in Fig. 8. Waste incinerator heat exchanger sprayed with alloy 6 is shown in Fig. 9, and a gate valve sprayed with alloy 6 by HP/HVOF is shown in Fig. 10.

Quality Hard Chrome in Edmonton, Alberta, Canada, is located in a large market for oil field tooling. HVOF has a dominant position in the manufacturing technology of this tooling. "An Overview of Thermal Spray Applications in the Oil and Gas Industry" (presented by Dale Harper and Elliott Sampson at the Northwestern Canada NACE Conference, Feb 1997) lists more than 40 of these applications. An example of an HVOF application sprayed at hard chrome is a bearing mandrel for "downhole" motors used in directional drilling. This is a changeover from chromium plating that is performance driven and has been a standard procedure for more than two years. The HVOF coating is lasting three times longer than the previous chrome plate. Figures 11, 12, and 13 show the bearing area being sprayed, parts awaiting finishing, and the finished parts.

Trends In HVOF

High-velocity oxygen fuel spraying started in the early 1980s. Initially, competitive designs continued the use of gaseous fuels. The success of later designs using less expensive and safer liquid fuel is driving the equipment manufacturers to develop HVOF systems using liquid fuel. Applications using both the liquid and gaseous fuel equipment are increasing at a rapid rate, and they will drive equipment materials development.

The increasing need for reliable and reproducible coatings is accelerating a technological advancement in the HVOF equipment that makes the process more "user friendly." The superior properties of HVOF coatings continue to open up opportunities for the growing use of these coatings for wear and corrosion resistance. One such opportunity is the replacement of chromium plating. Because of growing environmental concerns in North America and Europe, thermal spray coatings, and especially HVOF coatings, are being substituted for chromium plating. An HVOF coating has the added benefits of being able to be applied faster and much thicker than chromium plating. Materials development continues at a pace along with market expansion. New market opportunities open up the development of materials to enhance the performance of a coating for resistance against corrosion or wear or a combination of the two. The next issue will feature plasma applications. Contributors can contact us and be interviewed for possible inclusion in the next issue. Ideas for future issues are welcomed.

News from NSF

Japanese Government Budget for Materials R&D

Given the significant investments that the government of Japan is making in materials research, and the potential for increased U.S.-Japan collaboration, an attempt was made to identify major Japanese government programs in this area. While the gross total of the Japan financial year (JFY) 1997 science and technology-related (S&T) budget of the Japanese government amounts to 3002.5 billion yen (about US$26.3 billion at an exchange rate of yen 114 per dollar), no data are readily available at this time to show exactly what proportion of this total is being spent for materials research. Lacking these data, an attempt has been made to collect pertinent data from various ministries and agencies, in particular the Ministry of Education, Science, Sports, and Culture (Monbusho), Ministry of Industrial Trade and Industry's (MITI). Agency of Industrial Science and Technology (AIST), and the Science and Technology Agency (STA). When combined, these three agencies (Monbusho, MITI, and STA) account for about 83% of the total government S&T budget for this year.

The budget data presented represent a major proportion, if not most, of the government budget for materials research in FY 1997.

Ministry of Education, Science, Sports, and Culture (Monbusho)

The Ministry of Education, Science, Sports, and Culture (Monbusho) published a report recently to provide a summary of their "grants-in-aid" for scientific research for JFY 1997 (April 1997-March 1998). (Note: According to Monbusho, the yen figures quoted are still "tentative" as recommended by Monbusho's Science Council last April, which are still subject to change and cover only about 90% of all the grants to be approved eventually for this fiscal year.)

	JFY 1996	**JFY 1997**
Total number of applications for both new and continuing grants	83,958	87,513
Total number of new grants and continuing grants approved	29,470	29,694
Total yen amount approved: (in million yen)	70,436	77,458

From these data, it is estimated that approximately 3700 grants were made in material sciences amounting to about 12,700 million yen (about 127 million dollars) in total.

While details of each research project supported under these grants are yet to be published, there is a grant category called "priority-area research" in which certain specific "research themes" are designated as "priority areas." Once designated as a "priority research area," a sizable amount of money (from 50 to 600 million yen per year) is set aside annually over a period of 3 to 6 years so as to support a number of research projects falling in the designated priority area.

Agency of Industrial Science and Technology

The Agency of Industrial Science and Technology had its total annual budget increased to 162.1 billion yen in JFY 1997, an increase of 19.7 billion yen or 13.8% over the previous year's level of 142.4 billion yen.

The total annual budget of ISTF was increased to 28 billion yen in FY 1997, an increase of 6.2% from FY 1996 level of 26.4 billion yen, and is distributed for a number of national R&D projects in different technology areas as listed below:

Project areas:	**FY 1996**	**FY 1997**
Superconducting materials and devices	3,341	2,982
New materials	5,711	4,448
Biotechnology	2,931	3,397
Electronics, information, communication	4,125	5,673
Mechanical, aeronautics, space	6,118	7,496
Resources	1,018	2,035
Human life	2,795	1,678
Leading research (feasibility studies)	317	302
Miscellaneous expenses	66	60
Total (in million yen)	**26,421**	**28,070**

NSF to Adopt New Merit Review Criteria

The National Science Board (NSB) has approved new criteria for evaluating funding proposals submitted to the NSF. The Board, which is the governing body of NSF, took the action at its 28 March meeting. The approval culminates several months of discussion with the research and education community and analysis by a special task force, chaired by NSB member Warren Washington of the National Center for Atmospheric Research.

The Board action clears the way for the first change in NSF's merit review criteria since 1981. NSF expects to implement the new criteria beginning 1 October 1997. "Clearly the review process is critical to our effort to foster the highest standards of excellence and accountability in the use of limited funds," said NSF Director Neal Lane. "Our current system has a track record of success; but now we have an improved system to ensure that success continues and that excellence remains our first priority."

The NSF receives nearly 30,000 new proposals for funding per year and funds about one-third of them. Funding decisions are made largely through the process of merit review, including expert evaluation by selected peers. The NSF receives more than 170,000 such reviews each year to help evaluate funding proposals. "We know from surveys of our reviewers and staff that the current criteria are not always well understood or uniformly applied," said NSF Acting Deputy Director Joe Bordogna. "The new criteria are clearer and easier to apply."

The need to reexamine the current criteria was prompted by an evolution in NSF programs since 1981 to include a stronger focus on broad educational initiatives, the integration of research and education, and partnered research activities. It was also prompted by the adoption in 1994 of a new NSF strategic plan. "The new criteria can be applied more flexibly to this broad range of activities, and they better reflect the philosophy and spirit of our strategic plan," said Bordogna.

They also reflect the concerns of the science and engineering community, solicited during an eight-week comment period during which draft criteria were published and their merits debated. Hundreds of scientists, engineers, and educators offered both support and critique, as well as specific suggestions. Many of those suggestions are incorporated into the guidance that will accompany the new criteria.

Currently the agency asks reviewers to comment on four aspects of a proposal: (1) researcher performance competence, (2) intrinsic merit of the research, (3) utility or relevance of the research, and (4) effect on the infrastructure of science and engineering.

Under the new criteria, reviewers are asked to answer two questions regarding proposals for funding: (1) What is the intellectual merit and quality of the proposed activity? and (2) What are the broader impacts of the proposed activity? "Most importantly, they continue to make 'excellence' the hallmark of our merit review process," Bordogna emphasized.

News from Centers and Laboratories

Centre for Thermal Spray Processes (CPT)

The CPT was created to attain the following objectives: (1) work with a wide variety of materials, for use with thermal spraying techniques, (2) develop advanced technologies for the industrial applications of coatings, (3) investigate methods of producing coatings, (4) quality evaluation of coatings and failure analysis, and (5) postgraduate courses and seminars on specialized topics and technical courses for industrial personnel.

The activity of the CPT is a major project developed under the leadership of the working group of Physical Metallurgy (Department of Chemical Engineering and Metallurgy, University of Barcelona) in cooperation with several Spanish industrial groups. Through this joint project, the Centre can be regarded as a pioneer in the development of thermal spraying methods for engineering application in Spain and all of Europe.

Through the collaboration of Carburos Metálicos SA (a private company active in the chemical sector and leader in the industrial gas market) and the support of Sulzer-Metco (a manufacturer of spraying equipment and a supplier of thermal spray powder), CPT now provides a service to the country's companies in the surface coatings field, which is of great relevance to the improvement in service life of engineering components.

CPT's philosophy in answering the associated industrial challenges is to develop new technologies to meet the need for competitive products with improvement service life by cost-effective methods, in particular, to meet the demands for improved wear resistance and resistance to thermal degradation. Excellent facilities are available to the CPT group for the structural characterization of coatings and for the determination of coating properties such as wear, aqueous corrosion, and high temperature oxidation.

Contact: Centre for Thermalspray Processes, Centre De Projecció Tèrmica, Facultat de Quimica, Dept. d'Enginyeria Quimica i Metallurgia, C/ Marti i Franques, 1. E-08028-BARCELONA; tel: +34-3-4021302; fax: +34-3-4021638; http//www.ub.es/cpt/hr2. htm.

C2P: A New Center for Plasma Spraying in France

Created in Evry, France, in Sept 1995, C2P (Centre de Compétence en Projection Plasma) is now established for a wide range of industrial plasma spray applications, including APS, VPS, and IPS. The innovative CAPS (controlled atmosphere plasma spray) system, combines all these plasma spray applications, as well as the newly developed high-pressure plasma spraying (HPPS) process. The CAPS operating pressure ranges from 20 to 4000 mbar, a capability that makes it possible to apply almost any material to almost any substrate. This advantage is further enhanced at C2P, because the CAPS is coupled with a Controlled Atmosphere & Temperature CGA patented system (ACT). The versatility of CAPS is particularly apparent when chemically different materials are sprayed in sequence, as, for example, with TBCs. Another applications area in which C2P obtained impressive results was in the plasma spraying of ceramics onto polymeric composites. C2P conducts extensive cooperative research in France and abroad.

Contact: C2P: tel: (33)-1-60-76-30-60; fax: (33)-1-60-76-31-50; e-mail: C2P@mat.ensmp.fr.

Mission Statement for Joe Stricker, Chairman of ITSA

In 1997 and 1998, my mission is to build on the accomplishments of Jimmy Walker's chairmanship, as well as on the dynamic programs launched by our former chairman, Daniel Parker, and continued by our past chairman, Robert Dowell. Thanks to their efforts and foresight, the ITSA has reached new levels of professionalism and influence, qualities I am committed to supporting.

Our restructuring of the committees has already produced positive results. We have experienced a steady growth of new members, with a special focus on attracting international members. Our marketing and exhibit committees are actively supporting this growth and providing new business opportunities for our members, as well. The joining of TSS with the ITSA to publish *Spraytime* has resulted in a far more effective and prestigious publication. In my role as Chairman, I expect to further strengthen these agenda, as well as give our members the new educational, business, and social opportunities they expect.

Marketing Thermal Spray and ITSA

Jean Mozolic has accepted the chairmanship of the Marketing Committee and added two new members: Tony Rotolico and Peter Way of Engelhard. The Marketing Committee is now developing a "Buyer's Guide," which will profile ITSA members and be available to prospective buyers at our ITSA Information Centers. The Exhibit Committee, under the chairmanship of Jimmy Walker, assisted by Van Blasingame and Robert Unger, is pursuing new exhibit opportunities in addition to the AWS, Airline Plating Forum, and NACE events.

The AWS event, with an international attendance of more than 19,000, has generated membership leads from Indonesia, New Zealand, Slovenia, India, and Scotland. An ITSA Exhibit at the Airline Plating Forum resulted in membership leads and showcased ITSA companies as sources for HVOF technology as an alternative to chrome plating. NACE has long had an interest in thermal spray and has now formed a thermal spray subcommittee headed by Elliot Sampson of TAFA. They will feature thermal spray in their December issue of *Materials Performance.*

Many valued ITSA members are contributing to our ITSA exhibits at trade and technical events on a voluntary basis—among them, Dominic Filippis of Plasma Coating, Dale Gilbert of TAFA, and Larry Robbins, Scott Goodspeed, and Larry Pollard of Praxair.

ITSA 1997 Membership Growth

Membership Chairman Marc Froning reports that 18 new membership leads came in during our first quarter and that ITSA has voted in one new Associate ITSA member: Metal Spray Supplies Australia (MSSA), which was established in 1989 as a provider of thermal spray equipment, powders and auxiliary support systems. Contact information: Mr. Merv Radford, General Manager, 4/37 Veronica St., Capalaba, Queensland, 4157 Australia; tel: (61-7) 3823 1004; fax: (61-7) 3823 1005.

Send membership recommendations to Marc Froning at: Engelhard, 12 Thompson Rd., East Windsor, CT 06088; tel: 860/623-9901; fax: 860/623-4657.

ITSA Awards Scholarship Committee

Retiring chairman Albert Kay has distributed 100 applications to schools and, in addition, sent an application to each ITSA member with the request that the application be forwarded to a potential award candidate. Under Al Kay's leadership, the ITSA scholarship awards have expanded in the breadth and quality of applicants. With the new committee structure, John Read assumes chairmanship of the Awards/Scholarship Committee. Al Kay, however, will continue to serve on that committee, along with Frank Martin, Robert Debolt, Randy White, and Noel Riese.

A listing of the ITSA Scholarship Awards follows:

1996

- Etienne Bouyer, University de Sherbrooke
- Elena Petrovicova, Drexel University
- Saifi Usmani, State University of New York at Stony Brook

1995

- Brian Choules, Purdue University
- Xiao-Chuan Wang, University of Minnesota
- Weidond Cai, University of California, Irvine

1994

- Jeffrey Brogan, State University of New York at Stony Brook
- Timothy Hussey, Drexel University
- Srikanth Reddy, State University of New York at Stony Brook

1993

- Ravi Bhatkal, Rensselaer Polytechnic Institute
- Karlis Gross, State University of New York at Stony Brook

1992

- Robert Gansert, State University of New York at Stony Brook
- Jan Ilavsky, State University of New York at Stony Brook

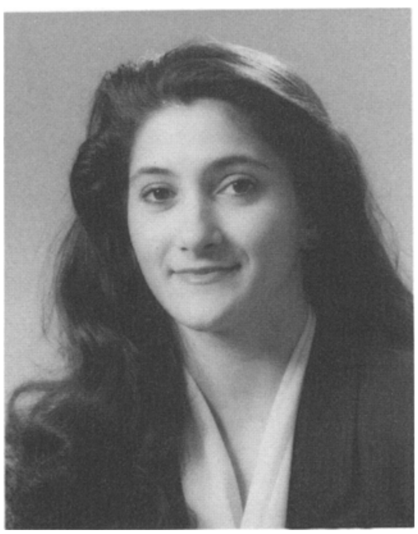
1991

- Lysa A. Wasielesky, State University of New York at Stony Brook
- Mahesh Mohanty, Drexel University

Anandan Promoted to Marketing Manager

Tanya Anandan has been promoted to Marketing Manager from Marketing Communications Manager at Wall Colmonoy Corporation (Madison Heights, MI). In addition to managing corporate communications, Anandan will develop marketing plans, pricing strategies, and research new market opportunities for Wall Colmonoy's Products and Processing Groups. Anandan joined the company in 1990 as Marketing Coordinator.

Contact: Tanya M. Anandan, Marketing Manager, Wall Colmonoy Corp., 30261 Stephenson Hwy., Madison Heights, MI 48071-1650; tel: 248/585-6400, ext. 244; fax: 248/585-7960.



T. Anandan

Jaramillo Promoted to International Sales Manager

Demetrio Jaramillo has recently been promoted to International Sales Manager for Wall Colmonoy Corporation (Madison Heights, MI). Jaramillo oversees all export sales and distributor negotiations in Latin America, Asia, and the Far East. He is also responsible for researching and pursuing new business opportunities and enhancing Wall Colmonoy's position in the global market.

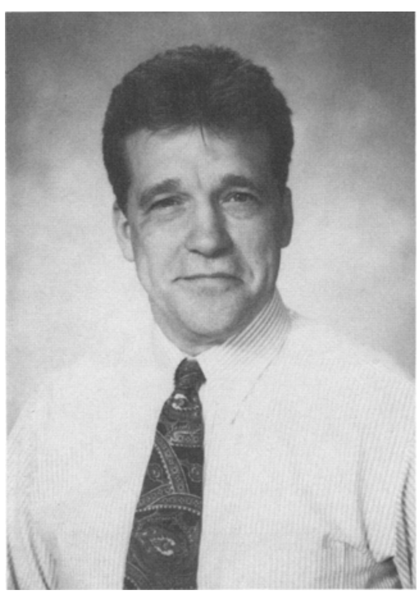
Jaramillo, bilingual in Spanish and English, is a native of Monterrey, Mexico, where he earned degrees in law and international business. He joined Wall Colmonoy in 1995 as Export Sales Administrator.

D. Jaramillo

Contact: Tanya M. Anandan, Marketing Manager, 30261 Stephenson Hwy., Madison Heights, MI 48071-1650; tel: 248/585-6400, ext. 244; fax: 248/585-7960.

Ellison Surface Technologies Hires Stewart

Ellison Surface Technologies (EST) has hired Ronald Stewart as Director of Quality. EST designs, engineers, and applies hypervelocity, plasma, and flame spray coatings. The EST home office and plant are in the Greater Cincinnati area. Another plant is in Rutland, VT.



R. Stewart

Mr. Stewart is a graduate of the Manufacturing Engineering program of the University of Cincinnati and is a Certified Internal Quality Auditor for the International Standards Organization (9000 series). He has been chief quality officer for several large manufacturing and fabrication plants and is an experienced ISO 9000 facilitator.

Contact: Tim Perkins; tel: 606/586-9300.

Sermatech Appoints President

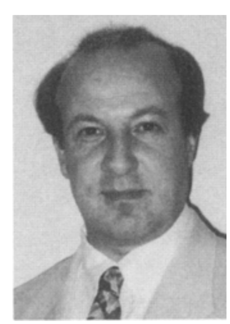
Sermatech Technical Services has named Michael W. Young as President. Mr. Young was most recently Senior Vice President of the company. Mr. Young joined Teleflex Inc., the parent firm of Sermatech Technical Services, in 1983 as Controller for the company's commercial products group. He was named a Vice President with Teleflex in 1988. In 1989, he became Vice President and General Manager of Sermatech Technical Services, then was promoted to the position of Senior Vice President in 1994.

Mr. Young holds a Bachelor of Science degree in accounting from LaSalle University and earned a Masters of Business Administration from Drexel University.

Contact: Mike Stock, Sermatech International Inc. 155 South Limerick Rd., Limerick, PA 19468; tel: 610/948-2833; www.sermatech.com.

Knight Named Director at Drexel University

Dr. Richard Knight has been named Director of Drexel University's CPPM (Center for Plasma Processing of Materials). He succeeds Dr. Ronald Smith who leaves to take over full time the management of Materials Resources International in Blue Bell, PA. Dr. Smith remains as Senior Technical Advisor to CPPM.



R. Knight

Andrew Muller—In Memoriam

Andrew Muller, a longtime, valued member of the International Thermal Spray Association (ITSA) since 1977, and a distinguished past chairman of ITSA, passed away on 17 April 1997. He was co-owner and president of Plasma Coating Corporation of Gardena, CA, and, as such, did much to advance the science of thermal spray to industrial users. Mr. Muller was a leading contributor to ITSA growth and served as a permanent member of the executive committee following his chairmanship. Condolences to: Mrs. Andrew Muller (Jane), 435 North San Gabriel Blvd., San Gabriel, CA 91775.