In The News

Publications and Education

Encyclopedia of Materials Characterization

Edited by C.R. Brundle, C.A. Evans, Jr., and S. Wilson

This book describes some 50 analytical techniques used in modern materials analysis for the characterization of surfaces, interfaces, and thin films. Each article is dedicated to an individual analytical technique and follows a standard format: a one-page tabular summary, a detailed description of how the technique works, what information it provides, its advantages compared to other techniques, its most common uses, and a look at some of its future trends.

Contents include imaging techniques, electron beam instruments, structure determination by diffraction and scattering, electron emission spectroscopies, X-ray emission techniques, visible/UV emission, reflection and absorption, vibrational spectroscopies and NMR, ion scattering techniques, mass and optical spectroscopies, neutron and nuclear techniques, and physical and magnetic properties. The content and format of the Encyclopedia is designed as a resource for materials scientists and engineers in any materials discipline, enabling the reader to understand the uses of analytical techniques without requiring that they become analytical specialists.

Thermal Spray Industry Environmental Guideline

This report is sponsored by the Thermal Spray Industry Group of ASM International, which includes Hobart/Tafa, the International Thermal Spray Association (ITSA), Metco/Perkin-Elmer, Miller Thermal, Plasma Technik, Plasma Technology Inc., and Zircoa. The ASM Thermal Spray Industry Environmental Guideline is a nonprofit venture that provides an informational tool for the thermal spray industry.

The Guideline includes: the executive summary, introduction and objectives (which describes the goals, pertinent environmental law, health, and related issues); past knowledge and experience; industry environment (characterization of thermal spray emission and waste streams); air emissions; waste emissions; industry position relative to environmental laws; recommendations; databases; references; and commercial information.

The "Air Emissions" chapter reviews the impact of the 1990 US Clean Air Act on the thermal spray industry. It summarizes the pertinent air quality issues in key states (California, Pennsylvania, Ohio, Texas, and New York) and compares them with standards in Canada and Europe. It further reports on the best available technologies for controlling emissions, typical measured characteristic emissions of the various thermal spray processes, the available sources of control equipment, and lists technical assistance. Remedial actions are also recommended. The "Air Emissions Testing" chapter includes characterization of thermal spray effluent plasma (internal versus external powder injection, wire arc, combustion etc.), powders (NiCr/Cr carbide, WC/Co, Cr_2O_3), and wires (NiCr). The characterization of sprayed powders and wires, sampled just before and after the collection devices, and downstream of all final filters, is detailed, along with powder size and mass concentrations, gas analysis/post-final filters for CO/C_xH_y (when applicable), and NO_x and ozone Cr^{6+} testing (using State of California and US EPA methods). A detailed report of the sampling procedures, documented results, and comparisons to known threshold limit values (TLVs) is offered.

The section on "Waste Emissions" reviews and characterizes typical waste streams in thermal spray systems. It reports the pertinent EPA regulations with respect to these wastes and reviews the legal procedures for handling these waste streams and lists technical resources available for assistance, as well as remedial actions.

The Guideline will be shipped in early Fall 1993. Free registration to the workshop to be held in the Fall of 1993 in Chicago, Illinois, entitled "Understanding and Controlling Thermal Spray Emissions" will be available to Guideline buyers.

Circle No. (3) on reader service card

Handbook for the Application of Thermal-Sprayed Aluminum

The "Procedure Handbook for Shipboard Thermal Coating Applications" (publication No. 0341 from the National Ship Research Program Coordinator) provides guidance and assistance to shipyards from two points of view. First, the Handbook is intended to guide a shipyard that is preparing to establish a thermal spray program for the first time in accordance with current US Navy requirements. The second objective is to assist shipyards that are currently involved in an active thermal spray program by providing information and data that can be used to analyze and assess their current methods, thus leading to potential improvements or cost savings.

Significant attention is placed on making this document useful to shipyards. In addition, the Handbook is a "hands-on" practical tool to benefit the wide range of personnel involved in the thermal spray arena, particularly planners, estimators, engineers, production supervisors, and shop managers. The Handbook outlines the theory and application of thermal sprayed aluminum (TSA) coatings, as well as describes facility requirements, training programs, equipment and application costs, quality, safety, and environmental issues. In addition, the key elements necessary to implement a shipyard thermal spray program are described and summarized.

This Handbook addresses aluminum coatings only, because this coating is currently being specified by the US Navy for shipboard corrosion control. Also, all information supports the requirements of the currently approved government standard for thermal spray (i.e., DoD-STD 2138, entitled "Metal Sprayed Coating Systems for Corrosion Protection Aboard Naval Ships" and included as an appendix). This volume makes several references to updated information contained in the draft version of DoD-STD 2138-A. All Navy contractors are required to comply with this document, which outlines stringent procedures for surface preparation and coating application, certification of facilities and operators, production, quality assurance, testing, and record keeping.

The research for this project was accomplished in several phases:

- Survey shipyards and subcontractors with respect to methods, production rates, and equipment; results are summarized in an appendix
- Identify and analyze current methods of thermal spray applications and related equipment usage
- Compile production rate data for various types of thermal spray applications
- Perform an industrial engineering study to determine overall costs per unit area
- Outline requirements and procedures leading to certification in accordance with DoD-STD 2138
- Assemble all data and information to create a thermal spray handbook

Also, visits were made to the following shipyards to tour thermal spray facilities and discuss the project surveys: Avondale Shipyards (New Orleans), Bath Iron Works (Bath, Maine), Ingalls Shipbuilding (Pascagoula, Mississippi), Puget Sound NSY (Bremmerton, Washington), and SIMA Naval Station (San Diego).

Circle No. (4) on reader service card

How to Optimize Design or Selection of Water Cooling Systems

A technical bulletin that discusses the principles of design and selection of cooling systems for thermal spray installations has been compiled by Hobart Tafa Technologies, Inc., Concord, New Hampshire. Both plasma and HVOF need high water pressure to cool the electrodes and other surfaces exposed to the flame or arc. Typically, both require dissipation of significant amounts of heat, from 55 to 110 kW.

Among the factors outlined in the Bulletin are deionized water, nucleate boiling, types of cooling water (variations within the United States, effects of scaling, fouling, corrosion, erosion, and microbial growth), primary water supplies (city, cooling tower, plant refrigerated), temperature and required flow of available water, and ambient air temperature.

Also included are formulas to determine options and the best type of system to fulfill particular requirements, e.g., to select between water-to-water heat exchangers, partially refrigerated systems, and totally refrigerated systems. The Bulletin, entitled "Fundamentals/Design and Selection of Water Cooling Systems" is available without charge from Hobart Tafa Technologies, Inc., Concord, New Hampshire.

Circle No. (5) on reader service card

Thermal Spray Technology Videocourse Produced by ASM

"Thermal Spray Technology," an eight-tape, full-color videocourse providing an understanding of thermal spray processing science for each thermal spray coating process, is available from ASM International. This videoseries presents the theory and practice of coatings, including coating application, and characterization and testing. Practical coating systems for electric arc, flame and plasma applications and practice, and interaction of thermal spray coatings with materials, are examined. This videocourse provides technically reviewed instructional materials developed by a panel of industry experts. The eight-part series covers:

- *Surface Science*: Wear, corrosion, hardening, carburizing, nitriding, electroplating, electroless plating, phosphating, vapor deposition, and hardfacing
- *Equipment and Theory—Combustion and Electric Wire Arc*: Thermal spray history, basic theory of coating processes, porosity, bonding, application, combustion spray processing and equipment, material feed, deposit characteristics, and HVOF
- *Equipment and Theory—Plasma Spray*: Theory of the fourth state of matter, air plasma spray, powder feed, particle distribution trajectory, LPPS plasma spray variations, material feed systems, controls, consoles and power supplies, ancillary equipment, safety, and hygiene
- *Processing and Design*: Bonding, cleaning, processing, masking, temperature control, spray pattern, process variation, automation, fusing, densification, finishing, and stripping
- *Materials*: Material production methods, particle classification methods, quality control, material specification, and standards
- *Applications*: Aerospace, automotive, biomedical, ceramic and glass, marine, non-skid, electronics, printing, processing industries, and textiles
- *Testing and Characterization—Methods and Mounting:* Variations in test equipment, metallurgy and materials, grain size, bonding, coating buildup, response generators and variations, metallographic procedures, sectioning, vacuum impregnation, mounting materials, and techniques
- *Testing and Characterization—Preparation and Procedure*: Specimen preparation, grinding, equipment, abrasive types, material reaction, deformation and smearing, polishing concepts and procedures, etching, lubricants, hardness, and tensile testing

"Thermal Spray Technology" (Order Code TSVPR 193) will be of value to those who are new to the field, or those who provide technical support in purchasing, sales, and administrative areas. Process, application, development and design engineers, as well as researchers and quality control personnel, may also find this series beneficial.

Circle No. (6) on reader service card

Quantitative Characterization of Microstructure

This course will be held in Charleston, South Carolina, from 17-18 July 1993 and is directed to all who deal with microstructures or two-dimensional images and who need to learn and apply these quantitative techniques in their own work. Thus, technicians and engineers will find this course of greatest value, although supervisors and researchers will profit from the additional insight afforded by this course. It is no longer sufficient to characterize an alloy microstructure qualitatively, i.e., a grain size in descriptive terms of "fine," "medium," or "coarse," or rely completely on comparison charts. The requirements for increased materials performance are becoming more and more demanding. Thus, it is inevitable that there is a greater reliance on and use of quantitative metallographic methods.

The course stresses the practical aspects of extracting quantitative microstructural information from the plane of polish. Such quantities as grain boundary area, volume fraction, grain and particle sizes, spacings, and lengths are readily determined. Participants will be able to decide what can be measured, how it can be measured, and which procedure is most effective. The emphasis throughout will be at the applied level, using real microstructures and familiar constituents to illustrate the methods. Simple manual procedures that yield numerical results quickly, and without excessive effort, are available.

The conference program includes Introduction to Quantitative Metallography (basic concepts, definitions, measurements); Basic Equations of Stereology (volume, surface, linear, numerical, and their interrelationships); Other Important Microstructural Quantities (size, intercept length, spacing, contiguity, directional characteristics, size distributions of particles and grains, calculations to obtain three-dimensional results, statistical quantities); and Advanced Topics (shape, curvature, fractography, gradients, clustering); Applications (basic microstructures, measurement plan, calculations).

The instructor is Dr. Ervin E. Underwood, Professor Emeritus, Georgia Institute of Technology, who has worked in steel mills, commercial research laboratories, aerospace companies, and as an expert witness and scientific consultant. He holds metallurgical degrees from Purdue and MIT and is co-inventor of patents based on quantitative microstructural evaluations.

Thermal Spray Activities

Activities of the Testing and Characterization Committee

The Thermal Spray Division of ASM International has a Testing and Characterization Committee. The Chairman is Walter L. Riggs, II of TubalCain, Loveland, Ohio. The overall objectives of this Committee are to establish a dramatic impact on the thermal spray community and to create a new format that facilitates the needs to establish such an impact. The Committee is addressing several issues of importance to the thermal spray community, as discussed below.

Mechanical Properties

An on-going study in tensile adhesion tests (e.g., ASTM C-633-69) and micro- and macrohardness tests is in progress. This effort is focused on understanding the precise requirements that industry needs for coatings and how such work can be scientifically rigorous. Contact Chris Berndt (516/632-8507) if you desire to participate in these activities.

Metallography

- G.E., Corp. had 100 samples of various coatings sprayed 2 years ago using different equipment and parameters to obtain a large range of microstructures. These samples are gradually being incorporated into a round robin study.
- The metallography measurements were complemented with pore symmetry and catscan analysis to verify results.
- Buehler, Ltd. performed extensive studies with G.E. to determine methods of metallographic procedures and repeatability of such procedures.
- Protech Lab Corp. presented the round robin results, which included microhardness and superficial hardness.

Update on ASTM Activities

The ASTM E4 Committee (Metallography) has developed guidelines for metallographic preparation of coatings. These are intended to be guidelines only and are not required procedures from ASTM. The first three procedures were due by November 1992. It takes approximately 2 to 3 years for approval from ASTM. The efforts of the ASM Thermal Spray Division have been greatly assisted by Buehler, Ltd., Protech Lab. Corp., Struers, Inc., and TubalCain, Inc. The ASTM F04 Committee (Medical & Surgical Materials & Devices) has a great interest and need to develop wear and adhesion standards for hydroxyapatite thermal spray coatings. Contact Chris Berndt (516/632-8507) for further details.

The Testing and Characterization Committee of the ASM Thermal Spray Division is looking for active members.

Circle No. (7) on reader service card

Opportunities to Participate in IDEA Program

The National Cooperative Highway Research Program's Innovations Deserving Exploratory Analysis (NCHRP-IDEA) project is funded by the United States Federal Highway Administration and state highway agencies in cooperation with the American Association of State Highway and Transportation Officials. The project is managed by the Transportation Research Board (TRB).

NCHRP-IDEA seeks to introduce new technologies, methods, or processes for application to highways and intermodal surface transportation through the development and testing of nontraditional and innovative concepts, including application of those from other technology sectors that have not yet been tested in the highway sector. NCHRP-IDEA will consider deserving innovations in any technology area for highway and intermodal surface transportation systems.

Investigators wishing to participate in the IDEA program are required to submit a three-page concept proposal to NCHRP-IDEA describing the innovation proposed for investigation and the potential impact of the innovation on current practice in accordance with the guidelines described in this project announcement. NCHRP-IDEA will review the concept proposal and, if it is found appropriate and promising, will invite the proposer to submit a more detailed proposal. The two-step proposal preparation process is designed to permit guidance and feedback from TRB on appropriate concepts before the detailed proposal is prepared. All IDEA awards are fixed price contracts not to exceed $100,000 and must be completed within 12 months. Technology emphasis areas for the first 2-year project cycle from October 1992 to September 1994 are as follows.

IDEA concepts will be characterized by one or more of the following features:

- Engineering and scientific innovations that offer significant promise for developing into usable and cost-effective technologies, processes, or products
- High-risk, but credible, technical concepts that offer potential for significant technological breakthroughs and large payoffs
- New concepts that offer the potential for advancing the state-of-the-art highway and intermodal surface transportation technologies, or those that may emerge into new technology areas for highway application
- Advanced concepts and products developed for other engineering applications, but not as yet tested or applied to highway practice
- Advanced technologies tested or used in overseas practice, but as yet not tested or proven useful in US practice.

Circle No. (8) on reader service card

Defense Technology Conversion, Reinvestment, and Transition Assistance: New Program from ARPA

This program addresses defense industry and technology-based activities under eight separate statutory programs and sets forth planned selection criteria. The Advanced Research Projects Agency (ARPA, formally DARPA) of the Department of Defense, the Department of Energy/Defense Programs (DOE/DP), the Department of Commerce's National Institute of Standards and Technology (DoC-NIST), the National Science Foundation (NSF), and the National Aeronautics and Space Administration (NASA) are collaborating in the Technology Reinvestment Project (TRP).

Funding (about $470 million) for TRP activities will be cost-shared with non-Federal government entities. Activities fall into three broad areas: technology development, technology deployment, and manufacturing education and training. Each of these areas relates directly to the TRP mission and strategy by stimulating the integration of the military and commercial industrial bases.

The TRP will stimulate the transition to a growing, integrated, national industrial capability that provides the most advanced, affordable, military systems and the most competitive commercial products. TRP programs are structured to expand high-quality employment opportunities in commercial and dual-use US industries and demonstrably enhance US competitiveness. This will be accomplished through the application of defense and commercial resources to develop dual-use technologies, manufacturing and technology assistance to small firms, and education and training programs that enhance US manufacturing skills and target displaced defense industry workers. The TRP will accomplish its mission through cooperative, interagency efforts that address the technology development, deployment, and education and training needs within both the commercial and defense communities. Concerted efforts will be made to bolster the economic competitiveness of defense-dependent enterprises and increase the availability of dual-use technologies for national security purposes.

Planned date for submission of proposals is 23 July, 1993. Announcement of initial awards is expected in the last quarter of fiscal year 1993.

For more information call: 1-800-DU-ALUSE (1-800-382-5873).

Circle No. (9) on reader service card

Research Program Summary

Westinghouse, SGS Tool Target Commercial Diamond Films

Westinghouse Electric Corp. and the SGS Tool Co., Monroe Falls, Ohio, have launched a $5.2 million effort to develop an efficient, high-volume technology for producing diamond films using the Westinghouse plasma torch with the chemical vapor deposition (CVD) process. The US National Institute of Standards and Technology recently revealed plans to provide $2.4 million in funding support over the 3-year term of the program. For the first year, now underway, NIST has made a commitment of more than $1 million.

Project managers report that a successful scale-up would cut the cost of diamond coatings from the current cost of $30 to less than $5 a carat, opening up a variety of applications. It would also give the United States the lead in the emerging market for diamond films, now estimated at $4 billion a year by the end of the decade. The primary target of the project is a coating for carbide tools that would greatly extend their useful life, substantially increasing industrial production by minimizing downtime for tool changes. In addition to applications based on the hardness of the diamond, uses that depend on its other unique properties are expected. Diamond is the world's best heat conductor and at the same time one of the very best electrical insulating materials, making it superb for electronic packaging. Its transparency to light, from infrared wavelengths to the far ultraviolet, makes it ideal for aircraft windows and missile domes. It is also corrosion resistant, has a low coefficient of friction, and can be used to make semiconductors.

The plasma torch/CVD effort combines the know-how of SGS, the leading supplier of precision rotary carbide tools, with the expertise of scientists at the Westinghouse Science & Technology Center (STC), Pittsburgh, Pennsylvania, in both diamond film fabrication and high-power direct current electric arc heating technology. The two firms will be assisted by the University of Minnesota, Department of Mechanical Engineering. "Over the past few years Westinghouse has become a leader in the development of diamond film production technology," said Arthur H. Long, manager of diamond film programs for Westinghouse, "and our leadership in large-scale industrial plasma torch technology goes back more than 30 years. Engineering these technologies into a practical, robust commercial-scale system will be the major challenge of our 3-year program."

Plasma torches for the Westinghouse/SGS/NIST program will be supplied by the STC plasma center in Waltz Mill, Pennsylvania, near Pittsburgh, where the experimental diamond production system will be installed and operated under the direction of Westinghouse plasma systems manager, Dr. Shyam V. Dighe. "Our rugged, commercially proven torches have found increasing use over the past decade in metals production, chemical processing and the breakdown of hazardous wastes," Dr. Dighe said. "Their multi-megawatt power ratings far exceed the 5 kW ratings of the microwave heat sources now commonly used with CVD apparatus. This high-power capability promises to greatly speed the formation of diamond film made by the chemical vapor deposition process, increasing the productivity of workers manning the process more than 100-fold. "

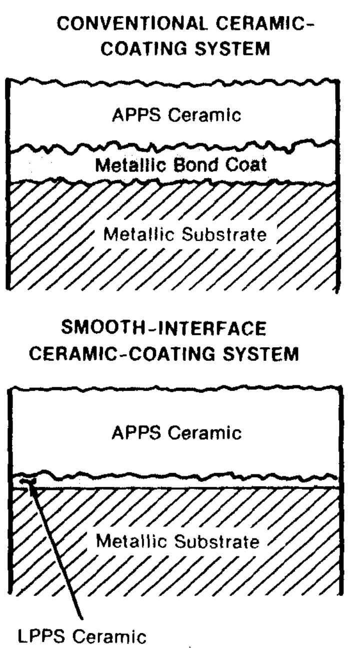
Arc plasma chemical vapor deposition is, according to a NIST statement, "one of the most promising" of several competing technologies for laying down quality diamond coatings on surfaces. In CVD, gases are introduced in various combinations into a closed chamber. They solidify on a heated surface to form films with a variety of desired compositions and properties. Gases that contain carbon are used to make diamond films, but common graphite will form instead unless a plasma of atomic hydrogen gas is fed into the chamber in quantities sufficient to stop graphite formation. A steady supply of heat is needed to ionize hydrogen molecules into the hydrogen atoms required. Besides the increase in power, program plans call for scaling up the CVD process maximum coating area from about 80 to about 6500 cm^2. Also included are plans to create an industrial users group.

Circle No. (10) on reader service card

Plasma-Spraying Ceramics onto Smooth Metallic Substrates

NASA, Lewis Research Center, Cleveland, Ohio, has demonstrated that rough metal/ceramic interfaces are no longer necessary to achieve good coating adhesion. In an experimental fabrication process, plasma-sprayed ceramic coats (e.g., zirconia/yttria-based thermal barrier coats) are bonded strongly to smooth metallic surfaces. The principal use of such coats is in protecting metal parts in the hot gas paths of advanced gas turbine engines.

Heretofore, plasma-sprayed ceramic coats have been adherent and durable only when applied over rough, plasma-sprayed metallic bond coats. This limitation is sometimes undesirable, for example, when a design calls for a particular oxidation-resistant bond coat that has to be applied by a method other than plasma spraying. The new process would be appropriate for many applications in which thermally insulating coats are needed on smooth metal substrates, as well as for other applications that involve such different types of ceramic coats as wear coats.



NASA, Lewis Research Center *In the smooth interface ceramic coating system (bottom), a smooth metallic substrate is first coated with a thin layer of LPPS ceramic, which is then coated with a thicker layer of APS ceramic. In the conventional ceramic coating process (top), a metallic substrate is coated with a metallic bond coat, the rough surface of which is then coated with the APS ceramic layer.*

The new process consists of (1) the application of an initial thin layer of ceramic on a smooth surface by low pressure plasma spraying (LPPS), followed by (2) the application of a layer of conventional, low thermal conductivity atmospheric pressure plasma-sprayed (APS) ceramic. The smooth surface can be an uncoated oxidation-resistant alloy, a metallic diffusion coat, or even a plasma-sprayed metallic coat that has been ground smooth; it can be nonoxidized or lightly pre-oxidized.

When correctly processed, the LPPS ceramic layer adheres to any of these smooth surfaces. However, this initial layer is rather dense and therefore less insulating and less tolerant of stresses and strains than thick conventional plasma-sprayed ceramic coats. Therefore, the LPPS ceramic is applied to a thickness of only about 1 mil (25 μm). This initial layer is sufficiently rough to enable the final layer of conventional APS ceramic to adhere.

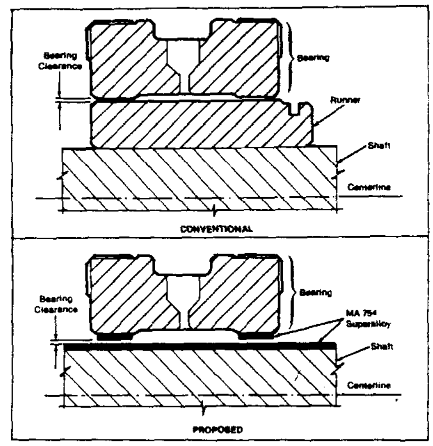
This work was performed by Robert A. Miller, William J. Brindley, and Carl J. Rouge, Lewis Research Center, and George Leissler, Sverdrup Technology, Inc. Point of contact is Lewis Research Center, Technology Utilization Offer, Anthony F. Ratajzak, Mail Stop 7-3, 21000 Brookpark Road, Cleveland, OH 44135. Tel: (216) 433-5568. Reference number is LEW-15146. Used with permission from *NASA Tech. Briefs*, Vol 17 (No. 4), 1993, p 53.

Circle No. (11) on reader service card

Coating Hydrostatic Bearings to Resist Ignition in Oxygen

NASA-Marshall Space Flight Center, Huntsville, Alabama, has used a plasma-sprayed superalloy against rubbing surfaces. Coats of the superalloy MA 754 would be plasma-sprayed onto the occasionally rubbing surfaces of hydrostatic journal bearings that operate in liquid and/or gaseous oxygen, according to a proposal. These coats would prevent the ignition and combustion that occur when components made of stainless steels or other conventional bearing alloys rub against each other in oxygen.

Presently, bearings are made compatible with oxygen by fabricating the occasionally rubbing components of silver or an alloy of mostly nickel and copper. Typically, these components include the bearing itself, plus a runner, which is the part that occasionally rubs against the bearing. The runner is press-fit or otherwise attached to the shaft, as shown at the top of the accompanying figure. Because the coefficient of thermal expansion of the bearing and runner differ from that of the shaft, it is difficult to maintain the tight control of the bearing clearance that is necessary for proper operation.



NASA-Marshall Space Flight Center

If the occasionally rubbing surfaces were coated with MA 754 superalloy as proposed, the bulk of the bearing could be made of the same material as that of the shaft, and the runner could be eliminated, as shown in the lower part of the figure. Because the combined thicknesses of the superalloy coats would be less than the overall radial thickness of the bearing, the different thermal expansion of the coats would have a negligible effect. Essentially, the shaft and bearing would thermally expand and contract together, and the thermal error in the bearing clearance would be eliminated.

The composition of MA 754 in weight percentages is nickel = 77.6 + x (where $x \leq 1.0$), chromium = 20, titanium = 0.5, aluminum = 0.3, yttria = 0.6, and iron = $1.0 - x$. The alloy is made by powder metallurgy processing, and the yttria imparts additional strength. This material has been shown to be compatible with liquid and gaseous oxygen at high pressure in promoted combustion and frictional heating tests. Because the material has a low coefficient of friction and high mechanical strength, it would undergo little deformation during a rub.

This work was done by Merle E. Funkhouser of United Technologies Corp. for Marshall Space Flight Center. Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Att. Robert L. Broad, Jr., Mail Code CC01, Marshall Space Flight Center, AL 35812. Tel: (205) 544-0021. Reference number is MFS-28636. Used with permission from *NASA Tech. Briefs*, Vol 17 (No. 20), Feb 1993, p 68-69.

Industry News

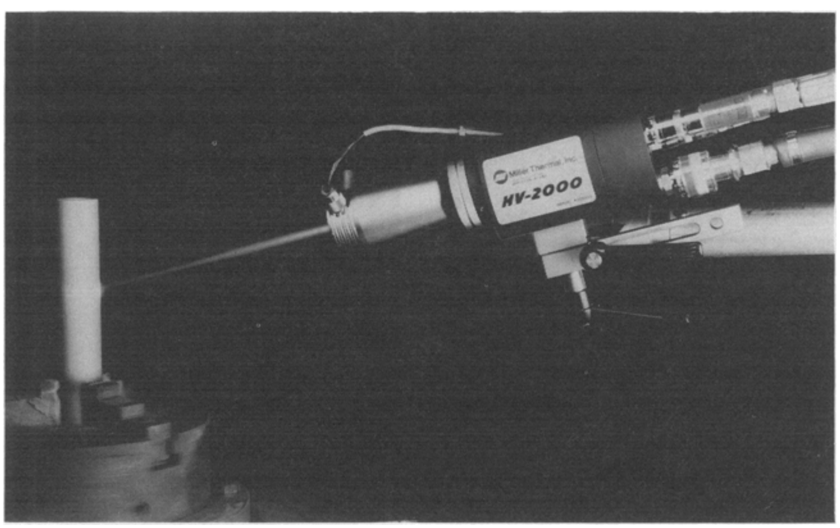
HVOF Gun for Full Integration into Automated Spray Cell Systems

Miller Thermal Inc., Appleton, Wisconsin, announces the development of the HV-2000 (HVOF) spray gun, designed specifically for full integration into automated spray cell systems. The HV-2000 provides dense, low-porosity, highly machineable, or wear-resistant coatings. The gas injection mixing system makes it possible to use this gun with high-temperature fuel gas combinations such as acetylene-oxygen, hydrogen-oxygen, propane-oxygen, or MAPP gas and oxygen. Acetylene fuel gas provides efficient spraying of materials with high melting points. Precision-machined components provide longer component life, high thermal efficiency, and low fuel consumption.

Particle speeds of the new HV-2000 are 10 to 30% higher than competitive HVOF systems, and gun parts may last 1 to 2 years as opposed to 1 to 2 weeks for some competitive HVOF guns. Specially designed combustion and gas injector mixing chambers completely melt powder particles before spraying materials onto the substrate at supersonic speeds. Fuel gas, oxygen, powder transport gas, and powder enter the gun centrally and axially to the combustion chamber and water-cooled expansion nozzle. This design provides unrestricted gas and powder flow.

The front gun housing is premachined to accept an optional Remote Auto Ignite/Sense unit. This unit uses a glow plug to light the gun and a photodiode sensor to detect the presence of the flame. The Ignite/Sense unit automatically shuts the unit down if the flame is not detected. Anodized exterior parts protect the gun from wear, and quick disconnects on hoses provide fast assembly and disassembly operations.

Circle No. (12) on reader service card



Miller Thermal Inc.

Spray Metal Tooling Cuts Time and Cost to Mold Prototype

A new method to make plastic prototypes rapidly and economically has been developed by Puritan-Bennett, Overland Park, Kansas. Three recently perfected technologies were coordinated for the project: CAD/CAM, stereolithography, and the Hobart/Tafa sprayed metal mold-making system.

Puritan-Bennett, a manufacturer of respiratory therapy devices, had completed the design for a new instrument and needed several units for an upcoming trade show and for clinical testing. There was still, however, a great deal of uncertainty in the design of the unit, and until the design could be verified with testing, the company was reluctant to make a large investment in tooling. In previous development efforts, Puritan-Bennett had used stereolithography and urethane casting to create prototypes of parts that would ultimately be injection molded. The housing for the new device, however, required specific material properties that could not be approximated by polyurethane. Therefore, the company evaluated three options for producing functional units in the desired material: machine parts directly from ABS stock, mold parts in machined aluminum single-cavity tools, and mold parts in spray metal tools made from stereolithography masters. The costs and lead times for each of the options to produce 20 sets of housing were:

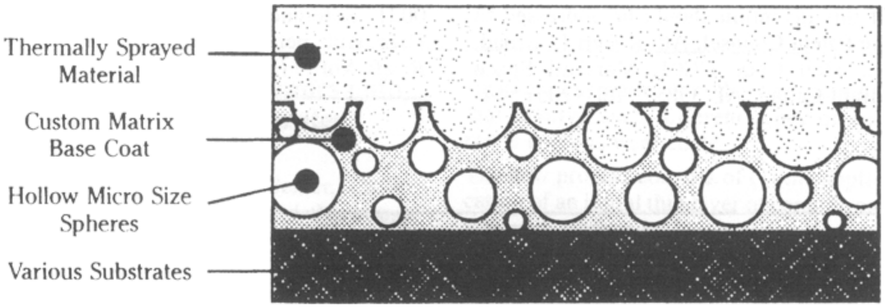
Prototyping	Total cost	Lead time, weeks
Machine from solid ABS	$42,000	10
Machined aluminum tooling	$33,300	9
Spray metal tooling	$15,200	5

Prototype Express, Arlington Heights, Illinois, created stereolithography masters directly from the Puritan-Bennett CAD models and the company elected to use Industrial Modern Pattern, Rosemont, Illinois, to create the Hobart/Tafa sprayed-metal molds. Once the tooling was completed and the initial ABS parts were molded, additional parts were run in two other materials to evaluate them as possible candidates for the production material. Compared to conventional methods, the use of sprayed metal tooling from stereolithography masters saved the company more than 69% in prototyping costs and reduced the delivery time by half.

Circle No. (13) on reader service card

Copperlok Antifouling Systems

Copperlok offers a long-term solution to reduce biofouling and offshore corrosion resistance. This coating allows a copper-nickel alloy to be applied to fiberglass, steel, ferro-cement, and wood, and can be extended to industrial usage, e.g., power plant applications, steel offshore structures, thermally conductive coatings to en-



Copperlok

hance heat transfer, and electromagnetic shielding EMI/RFI applications.

This patented process uses the thermal spraying of a copper-nickel alloy (90Cu-10Ni alloy) on a specially modified bond coat. The bond coat is an epoxy resin applied by a roller, brush, and/or spray. While the surface is still uncured, the fillers are sprayed on using a specially designed power-feeding system. After the surface is cured, it is abraded lightly and sprayed with the alloy. The atomized particles deform and embed into the undercuts, interlocking with the bond coat. The long-term antifouling properties are well established by numerous Copper Development Association reports.

Summary description of process

A modified epoxy coating is applied to the surface. The surface is abraded and power washed. The molten metal is atomized and propelled to the surface. The particles deform and embed into the undercuts and recesses, forming a strong mechanical bond. Added passes build up the coating to the required thickness.

Circle No. (14) on reader service card

Thermal Spray Masking Tapes

Tape masking creates a temporary barrier to prevent the application of a thermal spray coating to a specific area of a part. The FURON-CHR Division family of high-performance thermal spray masking tapes provides area protection from the effects of grit blasting and thermal spraying. These tapes will prevent the bonding of sprayed materials using the combustion and/or plasma spray methods of coating.

They retain their original physical properties, such as adhesion and dimensional stability, through the stress of thermal spraying. These tapes withstand temperatures up to 20,000 °F (11,100 °C) and particle velocities up to 1800 ft/s (550 m/s). All CHR thermal spray masking tapes are highly conformable. They are easily removed without breaking or leaving adhesive residue. Available tapes include fiberglass, silicone rubber-coated fiberglass, fiberglass-reinforced aluminum foil, and aluminum foil for HVOF processes.

Circle No. (15) on reader service card

Superfinishing from Supfina Machine Co., Ltd.

Many industries such as automotive, hydraulic, bearing, paper mills, plastics, etc. see the need for geometry, finish, and tolerances to enhance their parts. "Superfinishing" is a method of machining surfaces, including thermal spray coatings. The process entails the left-to-right vibration of one or more honing stones. It is technically known as "vibratory microstoning." Self-dressing, self-forming stones lie in constant contact with a workpiece, thereby removing chatter, waviness, or any amorphous skin caused from grinding. It will also remove turning grooves equivalent to that of hardfacing or normal turning.

FURON-CHR

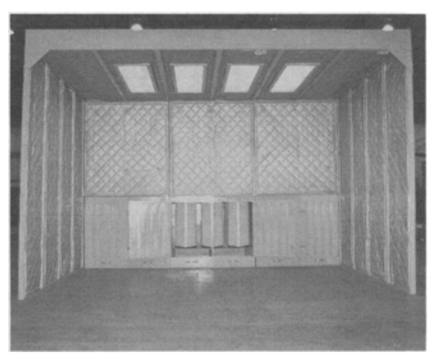
By using already existing machines, e.g., grinders, lathes, VTL's, planers, and tracer lathes, Supfina's pneumatic attachments can be retrofitted, allowing economic recovery of moneys already spent on existing machines and eliminating any need to purchase more machines.

Circle No. (16) on reader service card

Safe Air Dust Collection Booth

The JBI Safe Air Dust Collection Booth is a dust collection and clean-air recirculating system designed to improve safety and provide a cleaner, healthier work environment. This system controls in-plant air pollutants and removes fine hazardous foreign materials from various manufacturing sources that include wood sanding, metal grinding, and composite grinding. The booth meets OSHA clean air standards by removing 99% of air pollutants. The Safe Air Dust Collection Booths are made of 18-gage painted sheet steel with channel steel construction and are self-supporting. The modules are constructed of heavy-duty 12-gage steel and are of modular design.

An automatic control monitoring system includes a solid-state control panel with a photohelic pressure gage that monitors pressure drop and initiates the automatic cleaning process. The filters are cleaned when high-velocity air is automatically injected into each filter. The air injection is on a sequential basis to clean the filters and ensure maximum airflow and longer life. There are two types of filters available, one for fibrous material and the other for nonfibrous material.



JBI Safe Air Dust Collection Booth

Circle No. (17) on reader service card

On-Site Coating for Steam Turbines

The latest capability in Sermatech's growing array of on-site services is thermal spray coating for steam turbine components. This service makes it possible to coat large parts with complex geometries at the power station. It facilitates coating when outage schedules or other considerations make off-site processing prohibitive.

Sermatech's mobile service center is equipped to process components with GATOR-GARD® or conventional thermal spray. GATOR-GARD is an advanced thermal spray technology that produces coatings with exceptional purity and density. It is considered one of the best processes for wear-resistant coatings, because of its low application temperature and tight application parameters.

Sermatech's first project was the application of GG-M-115 to the outer cover and tenons (hp turbine rotor) from Tennessee Valley Authority's John Sevier unit No. 3. The on-site service was performed under the auspices of TVA's Arun Puri, manager, turbine generator component assessment and upgrade.

Sermatech offers two coating systems for steam path components: SPE-8515-HT (developed under EPRI sponsorship) and GG-M-115, a chrome carbide CoCrAlY coating applied by the GATOR-GARD process. Both coatings may be heat treated to maximize erosion resistance. Other applications for on-site services include thermal spray anticorrosion coatings for steam drums, dimensional restoration of valves, and coatings for diesel engines.

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Circle No. (18) on reader service card

Dynamet Donation to Penn State

Dynamet Powder Products, a division of Dynamet, Inc., Washington, Pennsylvania, announces the donation of an industrial robot and an automated guided vehicle (AGV) to Pennsylvania State University. The Clark/Cincinnati Milacron robot will be used for ongoing research and educational programs in the Department of Mechanical Engineering. The Clark vehicle will be used in the Department of Industrial and Management Systems Engineering to support courses in materials handling and flow.

In announcing the contribution, Peter Rossin, CEO, and Peter Stephans, President, stated "Dynamet is committed to supporting higher education, particularly in technical areas where the United States must continue to maintain a competitive edge." Dynamet, Inc. manufactures titanium and other advanced alloys, primarily for aerospace and medical markets. Its Dynamet Powder Products unit manufactures metal powders for critical tooling applications and for high-performance thermal spray and brazing processes. Products are available as powders and in a variety of consolidated forms.

Donald Petri Named Market Manager at General Plasma


Donald F. Petri

General Plasma has announced the appointment of Donald F. Petri as Market Manager, a newly created position. Petri will be responsible for the worldwide marketing of GPX Diesel-4 Coatings and other GPX coatings to power generation markets.

Petri began his marketing and sales career as central region sales manager for Emerson Electric Corp. and as national sales manager for the Stewart Warner Corp., Bassik Division. In his more recent affiliations, he served as manager of business development for United Technologies, Norden Systems, with responsibility for international programs in the Middle East. He is a graduate of United Technologies Global Leadership Program. Prior to joining General Plasma, Petri directed the worldwide aftermarket business for the GGT Division of Gerber Scientific and served as general manager of aftermarket business for the Farrel Corp.

Petri did his undergraduate work at the University of Missouri and George Washington University School of Engineering. He is currently pursuing a Masters in Liberal Arts studies at Wesleyan University in Middletown, Connecticut. Petri is a staff officer with the United States Coast Guard Auxiliary and a former gubernatorial appointee to the Connecticut state board for academic awards.

Hobart Tafa Appoints Regional Manager

Peter Kutsopias, previously with Plasma Technology, Inc., has joined Hobart Tafa Technologies Inc. as Southwest Regional Sales Manager. He will be located in the Dallas/Forth Worth area and will be responsible for all Hobart/Tafa sales and technical service in Texas, Oklahoma, Kansas, Colorado, New Mexico, Louisiana, and Arkansas. A graduate of the University of Wisconsin Eau-Claire, Kutsopias has more than 8 years experience in thermal spray technologies as well as in thin-film PVD and CVD coatings.

In this new position, his regional responsibilities will include Hobart Tafa's entire product line of electric wire arc, plasma and HVOF thermal spray guns, wire and powder feedstocks, computer-controlled, and robotic systems.

Thomas H. Via Elected to Board of Advisors of Robotics International


Thomas H. Via

Thomas H. Via, CMfgE, was recently elected to the Board of Advisors of Robotics International of the Society of Manufacturing Engineers for 1993-94. He is president of Via Technologies, a welding and manufacturing engineering consulting firm in Fairfield, California, and is a member of the AWS C2 Thermal Spray Committee and the ASM International Thermal Spray Automation Committee.

Submitting a manuscript?

See "Instructions for Authors" on page 195

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