In The News

New Literature

NTSC '96: Thermal Spray: Practical Solutions for Engineering Problems

This 1050-page book provides an international perspective from more than 200 technical papers on the latest developments in thermal spray technology and its applications. Contents range from theoretical developments in thermal spray processes and coating materials to materials characterization and direct applications. Sections cover Aerospace; Commercial Development; Materials, Processes, and Characterization; Power Generation; Thermal Barriers; and Infrastructure.

Cost to order this book, #6485NR, is $154.00 (ASM members $123.20). Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

Metallurgical and Ceramic Protective Coatings

Geared toward manufacturing engineers and materials scientists involved in the research, development, and application of protective coatings for use in severe heat, corrosion, and wear environments, this 340-page book explores in detail several methods primarily carried out in the condensed state, which have not recently been reviewed. In addition to chapters on coating methods, this reference also offers chapters on coating corrosion and measurement of coating adhesion. Contents include: Electrodeposition, Metallizing; Laser-Assisted Coating; Sol-Gel Derived Ceramic Films; Solid-Phase Cladding; Thermal Barrier Coatings; Pack Cementation Diffusion Coatings; Thermal-Spraying; Coating Degradation; and Coating Adhesion.

Cost to order this book, #6586NR, is $131.00 (ASM members $104.80). Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

Coatings for High-Temperature Structural Materials: Trends and Opportunities

This book assesses the state-of-the-art of coatings materials and processes for gas-turbine blades and vanes; determines potential applications of coatings in high-temperature environments; identifies needs for improved coatings in terms of performance enhancements, design considerations, and fabrication processes; assesses durability of advanced coating systems in expected service environments; and discusses the required inspection, repair, and maintenance methods. The promising areas for research and development of materials and processes for improved coating systems and the approaches to increased coating standardization are identified, with an emphasis on materials and processes with the potential for improved performance, quality, reproducibility, or manufacturing cost reduction.

The contents include: Executive Summary, Introduction, Application Needs and Trends, Materials and Processes, Failure Modes, Engineering Considerations, Refurbishment of Coated Structure, Near-Term Trends and Opportunities, Long-Term Opportunities and Innovative Systems, References, and Appendices (Testing And Standards, Radiation Transport in Thermal Barrier Coatings, Survey of Nondestructive Evaluation Methods, Modeling of Coating Degradation, Manufacturing Technologies of Coating Processes, Example of a Coating Designation System, and Biographical Sketches of Committee Members).

The Committee on Coatings for High-Temperature Structural Materials of the National Research Council consists of: Robert V. Hillery (chair), GE Aircraft Engines, Cincinnati, OH; Neil Bartlett, University of California, Berkeley; Henry L. Bernstein, Southwest Research Institute, San Antonio, TX; Robert F. Davis, North Carolina State University, Raleigh, NC; Herbert Herman, State University of New York, Stony Brook, NY; Lulu L. Hsu, Solar Turbines, San Diego, CA; Wen L. Hsu, Sandia National Laboratories, Livermore, CA; John C. Murphy, Johns Hopkins University, Laurel, MD; Robert A. Rapp, Ohio State University, Columbus, OH; Jeffrey S. Smith, Howmet Corporation, Whitehall, MI; and John Stringer, Electric Power Research Institute, Palo Alto, CA.

ISBN 0-309-05381-1; 1996, 102 pages, 8.5 × 11, $29.00 US Price; $35.00 Int'l U.S. Dollar Price; £23.95 Int'l Pound Sterling Price, Contact: http://www.nap.edu/bookstore/isbn/0309053811.html.

Fatigue and Fracture, Volume 19, *ASM Handbook*

Providing a working knowledge of fatigue and fracture properties in actual engineering practice, this latest addition to the *ASM Handbook* series is especially useful in evaluating test data and helping the reader understand the key variables that affect results. It will also give the reader a better grasp of fracture mechanics to aid in life assessment and life extension components.

Sections include: Fatigue Mechanisms, Crack Growth, Testing, Engineering Aspects of Fatigue Life, Fracture Mechanics of Engineering Materials, Fatigue and Fracture Control, Castings, Weldments, Wrought Steels, Aluminum Alloys, Titanium Alloys and Superalloys, Other Structural Alloys, Solders, Advanced Materials. Appendices contain comprehensive coverage of fatigue

strength parameters and stress-intensity factors.

Approx. 950 pages ISBN: 0-87170-385-8. Cost to order this book, #6197F, is $160.00 (ASM members $120.00). Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

ASM Handbooks on CD-ROM

Occupying 19 oversized reference volumes containing a total of more than 17,000 pages, the ASM Handbook series focuses on the properties and behavior of metals (particularly steels) and the processes used in the manufacture and fabrication of components. Information on selected nonmetallic materials, such as plastics, ceramics, and composites, has been added in recent years.

In making the transition to a KR OnDisc product, the new CD-ROMs will feature Knight-Ridder Information's new Dynatext Electronic Book Technology, in which each individual screen resembles a page of a book, but with complete electronic search capability. The CD-ROMs will cover the full text of the *ASM Handbooks*, and corresponding tables, illustrations, and photographs will be presented in context. The CD-ROMs will display a table of contents that can be expanded or reduced, depending on the need. Hypertext links to references also will be provided.

The ASM Handbook Series on CD-ROM will be brought to market in subset "collections." The first will comprise a metals properties and performance collection, containing Vol 1, *Properties and Selection of Irons, Steels and High-Performance Alloys;* Vol 2, *Properties and Selection of Nonferrous Alloys and Special-Purpose Materials;* Vol 13, *Corrosion;* and Vol 18, *Friction, Lubrication and Wear Technology.*

Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

Testing and Failure Analysis

The 370-page conference proceedings emphasize current and emerging techniques and technologies used for failure analysis, with additional screening tests on electronic systems and components. Topics include: Process Analysis Techniques, Packaging/Assembly Related Analysis Techniques, EOS/ESD, Nonsilicon Devices, Vendor-Equipment Topics, Testing, and Comprehensive Case Studies.

Cost to order this book, #2022NR, is $108.00 (ASM members $86.40). Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

Predictive Corrosion and Failure Control in Process Operations

The principles of Asset Loss Risk—an approach to keep refining, petrochemical, and processing plants running cost efficiently—are described in *Predictive Corrosion and Failure Control in Process Operations,* published by ASM International. Written by P.F. Timmins, this 220-page book explains Asset Loss Risk as controlling expenses by identifying and focusing on key equipment at greatest risk of breakdown. When all departments—maintenance, inspection, and operations—are organized to run in this predictive mode, costs are reduced and profitability increases. Particular emphasis is placed on controlling corrosion, which has a substantial impact on maintenance expenditures. Also described is process corrosion (featuring an array of mechanisms), management of change, and condition assessment. Fracture mechanics is discussed at length in terms of cost-benefit and methodology, covering specific applications such as cast irons, cast and wrought steels, pressure vessels, pressure tubes, stress maps, and failure assessment diagrams.

Cost to order this book, #6487NR, is $128.00 (ASM members $102.40). Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

Nickel and Iron Aluminides: Processing, Properties, and Applications

The 240-page proceedings offer the results of work from scientists and engineers representing ten countries. More than 30 symposium papers cover science and alloy development, technology and processing, and commercialization and applications. Topics include: Alloy Design; Mechanical Properties; Superplasticity; Oxidation and Hot Corrosion Behavior; Powder Production and Processing via Reaction Synthesis and Thermal Spraying; Commercial Applications such as Heat-Treating Fixtures, Permanent-Mold Castings and Centrifugal Castings for Processing Steel.

Cost to order this book, #6490NR, is $118.00 (ASM members $94.40). ISBN: 0-87170590-7. Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

Quenching and Control of Distortion

The 400-page proceedings cover technologies for both ferrous and nonferrous metals, with a particular focus on the most recent and innovative developments. Papers range from theoretical to practical applications, covering a range of topics including methods of measurement of distortion, residual stress, predictive techniques, process technology development, and equipment. Contents include: New Quenching Methods, Equipment, Additive Technology, Optimization of Quenchant Fluid Flow, Cooling Curve Interpretation, Alloy Development, Experimental Methods of Measurement, Process Modeling, Reduction Methods, Process Controls, Surface Coating Effects, Non-Quench Stress Generation Processes.

Cost to order this book, #6486NR, is $102.00 (ASM members $81.60). Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

Thermo-Mechanical Processing: Theory, Modelling, Practice

The 400-page proceedings contain nearly 30 papers detailing the following technical sessions: Fundamentals, Modeling, Special Materials, and Processing and Properties.

Subject areas include: Recrystallization Behavior and Microstructural Evolution of Some Alloy Steels and Aluminum Alloys, Modeling of Microstructural

Evolution and Properties Prediction, Recrystallization Rate and Transformation Behavior, Thermomechanical Processing (TMP) of a Gamma Titanium-Aluminide Alloy and Copper Alloys; Property Control and Effects of TMP on Hot-Rolled Steels; Microstructural Evolution and Effects of TMP on Cold-Rolled Steels; Effects of Heat Treatment on Al-Extrusion Mechanical Properties, Influence of Hot Rolling on Through-Thickness Structure of Al Thick Plate, and Microstructural and Texture Evolution of Hot-Rolled and Annealed Al Can Stock.

Cost to order this book, #6460NR, is $102.00 (ASM members $81.60). ISBN: 0-87170593-1. Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

Failure of Materials in Mechanical Design

This 654-page reference guide goes beyond basic fundamentals, offering new insights on how to apply theory to actual design applications. This new edition offers updated material on state-of-the-art developments in fracture mechanics as well as new material on crack development and behavior. As an added benefit, new problems and real-world examples illustrating methods to predict and analyze failure from a design perspective are also detailed.

Topics include: Failure Prevention Analysis; Modes of Mechanical Failure; Life Prediction and Fracture Control; Use of Statistics in Fatigue Analysis; and Failure Modes from Corrosion, Wear, Impact, Creep, Stress Rupture and Fatigue.

Cost to order this book, #6585NR, is $99.00 (ASM members $79.20). ISBN: 0-471-558915. Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

NDE in the Nuclear and Pressure Vessel Industries

The 600-page proceedings from this ongoing conference series contains information that plays a major role in promoting effective inspection of plant components including the pressing issue of performance demonstrations. Other topic areas covered include: experience and developments in the inspection of major components, improvements in inspection technology, and the role of inspection in ensuring the structural integrity of the plant.

Technical sessions include: Performance Demonstration; Steam Generator Tube Inspection; Materials-Properties Measurement; Reactor Pressure-Vessel and Primary Circuit Inspection; Advances in Ultrasonic Methods; Advances in Non-Ultrasonic Methods; Major-Component Inspection; Austenitic-Component Inspection; Modeling; NDE in Structural Integrity.

Cost to order this book, #6204NR, is $115.00 (ASM members $92.00). ISBN: 087170-589-3. Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

Properties and Units for Engineering Alloys

Ideal for quick, everyday reference, this 225-page *Ready Reference* groups all pertinent information, including foreign names and parameters, on a single page. The book also includes indexes for foreign abbreviations, names of properties, and complete conversion factors.

To ensure usefulness and accuracy, the book was compiled and reviewed by the Materials Properties Database Committee of ASM International. Coverage of mechanical properties includes bearing, bending, compressive, creep, damping, deformation, elastic, fatigue, forming/pressing, fracture, hardness, shear, and tensile. Physical properties include atomic, corrosion, electrical, magnetic, mass, microstructure, surface, and thermal.

Cost to order this book, #6483NR, is $65.00 (ASM members $59.00). Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

Materials Properties Handbook: Stainless Steels

This 500-page book offers detailed data sheets that provide a general description of the alloy, chemical compositions, product forms and fabrication characteristics, product conditions, applications, specifications summary and commercial equivalent grades. Each alloy is cited with extensive tabular and graphical data on physical (electrical, magnetic, and thermal), mechanical (elastic, tensile, fatigue, fracture, and plastic-deformation behavior), and corrosion properties (general corrosion behavior, corrosion-resistance ratings, unsuitable environments, uniform corrosion rates, and more).

Stainless grades covered include types: 201, 301, 303, 304, 310, 316, 317, 321, 347, 348, 403, 410, 434, 440A, 444, 446, 2205 (S31803), 15-5 PH, 17-4 PH, and AM 355.

Cost to order this book, #6195NR, is $192.00 (ASM members $153.60). Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

The Quality Book CQM Review

This 425-page comprehensive looseleaf workbook identifies and explains the best organizational-change methods including: quality management, realization of procedures, learning organization, reengineering, strategic visioning, and total customer service.

Contents include: Quality and Competitiveness; Quality Standards, Organizations and Their Functions, Quality Needs and Overall Strategic Plan; Customer Satisfaction and Focus; Product Development and Quality; Project Management; Continuous Improvement; Human Resources Management; and Training and Education.

Cost to order this book, #6582NR, is $88.00 (ASM members $70.40). Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

Handbook of Corrosion Data, Second Edition

Handbook of Corrosion Data, second edition, a source of corrosion data in one volume, has been greatly expanded—with the addition of nearly 80 corrosive agents, including soil—the already extensive coverage in the first edition.

Moreover, the new entries add up to more than 200 additional pages and nearly 100 new references. At least one reference is given for each tabular entry, which allows users to find additional information on the item.

The first part contains summaries on the general corrosion characteristics of major metals and alloys in various corrosion environments. Information in the second part is organized alphabetically by chemical compound and the data for each corrosive agent/compound are presented in tabular form, which has been standardized throughout the book.

Cost to order this book, #6407NEt, is $196.00 (ASM members $ 156.80). ISBN: 0-871705184. Contact ASM Member Services Center, Materials Park, OH 44073-0002; tel: 216/338-5151, ext. 900; fax: 216/338-4634; e-mail: mem-serv@po.asm-intl.org; http://www.asm-intl.org/.

The Iron-Nickel Alloys

The low-expansion alloy Invar was discovered in 1896 by C.E. Guillaume. The discovery was rewarded with the Nobel Prize in 1920 and gave rise to a whole family of iron-nickel alloys whose use is now widespread in a large variety of both everyday and high-technology applications. Published to commemorate the centenary of this discovery, *The Iron-Nickel Alloys* brings together the knowledge and experience of 38 specialists, including users, metallurgists, and scientists. It provides an overview which updates and completes older publications by Villachon and Josso and demonstrates the close relationship between alloy and product development and the evolution of user technologies. It emphasizes the profound influence of applications on the design, manufacture, and implementation of these materials, in fields as varied as electronics, information technology, television, safety devices, watchmaking, and cryogenic transport.

After a brief outline of the historical development of these products, Part 1 of the book describes the physical metallurgy of these materials and the alloy families concerned, together with the relationship between their exceptional physical properties and their different applications. Subsequent chapters then discuss the related phase diagrams and the specific manufacturing processes required to obtain these properties in practice.

Part 2 of the book is devoted to applications. The different families of alloys appear again, this time via their functions, their physical and metallurgical properties being linked to their implementation in the form of components. The functions fulfilled include sensing, measurement, regulation, and safety assurance, involving devices such as thermostatic bimetals, transformer cores for ground fault circuit-breakers, magnetic shields, and so forth. Electronic display systems and electronic components are treated in detail. Among the wide variety of applications, particular attention is paid to those that appear to offer the greatest potential. The metallurgy described is both complex and evolutive. The authors have succeeded in providing reviews readily accessible to the nonspecialist, placing an emphasis on the understanding of the particular features of the iron-nickel alloys and their relationships to the different applications. The book can thus be used as a specialized textbook by students or as a metallurgical handbook by alloy users. It clearly illustrates how specific materials properties are used by metallurgists and design engineers in high-technology applications.

The Iron-Nickel Alloys is edited by Gérard Béranger, François Duffaut, Jean Morlet, and Jean- François Tiers. Hardback ISBN: 1-898298-49-1, price is $130, Pub. 1996 by Lavoisier Publishing Inc., c/o Springer Verlag, P.O. Box 2485, Secausus, NJ 07096-2485; tel: 800/SPRINGER; fax: 201/348-4505; e-mail: orders@springer-ny.com.

Society News

News from Michael J. DeHaemer-ASM Managing Director

ASM Blends Youth, Experience in New Lead Team

When faced with evolutionary change in the executive office, strong organizations build on the traditions of past leadership, adding new personnel that bring fresh perspectives, ideas, and enthusiasm.

At the end of 1996, Edward L. Langer left ASM International after 30 total years of service to the Society. I am very grateful to Ed for the wonderful support he has given me during the past few months, and I know that I have some very big shoes to fill as ASM Managing Director.

As of 30 November, Stanley C. Theobald, Associate Managing Director, left ASM after 18 years of excellent service to our Society. He will become Group Director—Finance & Administration for the Society of Automotive Engineers (SAE). I know I speak for our entire organization when I say that we will miss Stan's talent and enthusiasm.

To maintain the strong structure of our Society's administrative leadership while adding fresh perspectives, I am pleased to announce the following promotions within ASM staff, effective 15 November.

William W. Scott, Jr. has been promoted to Associate Managing Director, while retaining the title and duties of Technical Director. In this capacity, Bill will be responsible for technical excellence, publications, and electronic data, as well as ASM's total quality management program.

Thomas S. Passek (Assistant Director, Chapter and Membership Development) has been promoted to Director, Society Activities. In this position, Thom will be responsible for membership, chapters, student and university relations, and international activities, including our Canada, Europe, and India Councils.

William S. Kornbau, CPA (Controller) has been promoted to Director, Finance and Administration. In this position, Will is responsible for financial services, purchasing, ASM's warehouse and post office facilities, and Materials Park building services.

W. Douglas Knowles, Ph.D. (Manager, Information Systems) has been promoted to Director, Information Systems and Technology Planning. In this position, Doug is responsible for strategic planning of computer and communication systems infrastructures to support ASM Vision 2001 and all ASM operations. He is also responsible for the serv-

ices provided by the ASM Member Services Center.

Robert C. Uhl (Director, Marketing and New Service Development) and Margaret M. Weir (Director, Education) will continue to share their knowledge, experience, ideas, and enthusiasm with us as members of our Lead Team.

Human Resources and coordinator of Society awards will report to the Managing Director.

I believe that our newly comprised Lead Team combines youth with experience to create a strong and effective organizational team. I look forward to working with them to achieve the objectives of ASM Vision 2001 and to better serve the members of our Society.

Education News from Accreditation Board

The Board of Directors of the Accreditation Board of Engineering and Technology, Inc. (ABET) approved ABET's Engineering Criteria 2000 for phased implementation beginning with evaluations in the fall of 1998. 1995-96 ABET President Winfred M. Phillips said, "In the early passage of Engineering Criteria 2000, the ABET Board has shown outstanding foresight and has ensured that engineering education will enter the 21st century with a sound plan for the future."

Engineering Criteria 2000, a simplified, flexible set of outcomes-based criteria that support curriculum innovation and continuous program improvement, "represents the first major change in engineering criteria in over four decades," noted Dr. Phillips. He added, "The industrial sector has been extremely supportive of Engineering Criteria 2000 and has anxiously awaited this reform." President Phillips reflected that "many of the ABET accredited engineering programs, the ABET Board, the Engineering Accreditation Commission (EAC), the ABET Industry Advisory Council (IAC), the Accreditation Process Review Committee (APRC), and the ABET staff have worked together since the late 1980s to bring about the accreditation reform that Engineering Criteria 2000 represents."

For information on the implementation of ABET's Engineering Criteria 2000, visit ABET's web site at http://www.abet.ba.md.us. Proposed program criteria for the various disciplines represented by the engineering professional technical societies are available at the ABET web site for review and comment. It is expected that the program criteria will be presented to the Board for approval at the Fall 1997 Board meeting. ABET's web site is continuously updated with information on the implementation of Engineering Criteria 2000 and outcomes assessment. Visitors to the site will find conference and meeting dates, resource material, and, early in 1997, an Internet discussion forum for issues related to outcomes assessment and Engineering Criteria 2000.

ABET is a federation of 29 engineering professional technical societies that represent more than 1.8 million engineers. ABET's main objective and responsibility is the maintenance and improvement of the quality of education in engineering, engineering technology, and engineering-related areas. Through its accreditation commissions, committee, and Board of Directors, ABET addresses current and future issues, implements studies, and develops policies, some of which become part of the criteria used by the accreditation commissions to evaluate engineering programs in their respective fields.

News from the Japan Thermal Spraying Society

In 1997, the Japan Thermal Spraying Society (JTSS), now under the leadership of Prof. Dr. Atsushi Hasui, will mark its 40th anniversary. The first applications for thermal spray technology in Japan are traced back to 1921 and focused primarily on decoration of bronze statues and anticorrosion treatments of steel structures. With the spread of the technology, there arose a demand for unification and standardization of thermal spray. JTSS was established in 1957.

Today, thermal spray technology is regarded as a leading industrial surface treatment in heat and wear-resistant applications, as well as anticorrosion, and there are many more thermal spray procedures and coating materials in use. An estimated 200 companies now specialize in thermal spraying, most operating under very disciplined conditions. "In order to obtain the expected performance of the coating applications, on the part of manufacturers and users," says JTSS, "applicators require expertise in many related areas and technicians are expected to apply thermal spray coatings with a very high degree of reliability."

JTSS, as a scientific and technical organization with more than 1000 members, supports the development of this expertise through a variety of programs: publications; conferences; training and certification programs for technicians; standardization in techniques and quality; research and development, information exchange, and international cooperation.

"International cooperation is very important to us," stresses JTSS, "in our goal to develop higher standards for thermal spray performance." The Society has cosponsored a number of thermal spray conferences in China and Korea, and they are currently working with such agencies as SES (Surface Engineering Society) of the United Kingdom to develop programs. They participate regularly in the International Thermal Spray Conference. ITSC'95 was held in Kobe, Japan.

News from the ASM Thermal Spray Society

With its finger firmly on the pulse of the latest developments in United States and international thermal spray arenas, the ASM Thermal Spray Society (TSS) has made giant strides forward in just a little more than two years since the Society was formed in June of 1994. Membership now totals over 900, and TSS has recently announced working agreements with the German Welding Society (DVS), the International Thermal Spray Association (ITSA), and the National Organizing Committee (NOC) of France, which will host ITSC'98 in Nice.

"Much has been accomplished," says outgoing President Ronald Smith, who passed the baton to incoming President Robert Tucker at NTSC'96, "and we look forward to many more accomplishments in the future."

Six committees are established and moving ahead in carefully focused directions: the programming committee, which is responsible for new technical programs, session and conference planning; a technology development committee, which creates forums for information exchange and planning; an industry development committee mandated to support industry growth and new applications; a training and certi-

fication committee, which is developing educational materials and programs and promoting certification systems; and finally, a "best practices" committee dedicated to developing practices, "pre-standards" and liaisons with "standards" groups.

"The plans are in place," says Dr. Smith, "and thanks to the energy of our committees, our board and our membership, the plans are being put very ably into motion."

Along with publishing this journal, TSS has also established a web site for the transmission of electronic information.

New Products

CAT Powders from Praxair

Praxair Specialty Powders, Indianapolis, IN, announces a new line of carbide activation technology (CAT) powders produced by a proprietary fabrication process in which discrete hard wear phases are encapsulated in a metallic matrix. The technology will initially focus on the CrC-NiCr family offering powders with controlled microstructures and engineered chemical formulations to produce coatings that provide a balance between high-temperature corrosion protection and wear resistance.

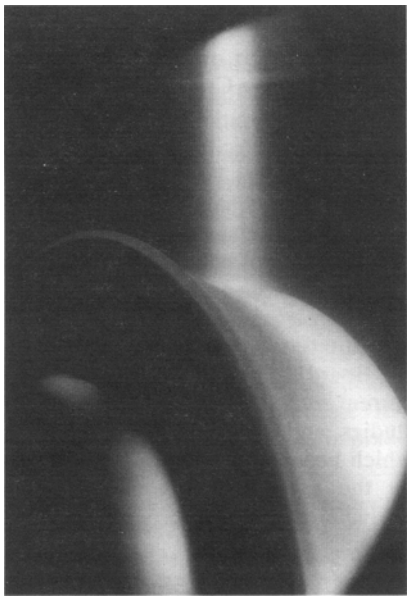
The CrC-NiCr powders exhibit higher deposit efficiencies, better chemical homogeneity, and produce thermal spray coatings with lower stress and comparable hardness, abrasion resistance, and corrosion protection to competitive CrC-NiCr prealloyed powders. Although emphasis will be placed on HVOF coatings, the powders will be compatible with all types of thermal spray equipment and they are designed for a broad base of uses ranging from the traditional CrC-NiCr gas turbine and industrial thermal spray applications to hard chrome plate replacement and automotive coatings.

Contact: Praxair Specialty Powders, Dean D. Hackett, Praxair Surface Technology, Specialty Powders, 1555 Main St., Indianapolis, IN 46224; tel: 800/825-3093; fax: 800/234-6738.

Howmet Introduces Spraycast-X Process

Spraycast- X, a Howmet-modified process of Osprey Metals, Ltd., is an alternative production technology for processing advanced, high-performance superalloys. Designed for demanding aerospace applications, the process uses vacuum melting, followed by high-purity, argon-gas atomization.

The Spraycast-X Process is characterized by a direct, one-step conversion of vacuum-melted superalloys to semi-



The Spraycast-X Process

finished ring shapes. The inert production environment permits a clean process and high deposition rates. It also enables the output of fine-grained components with nondendritic structures.

The current capabilities of the Spraycast-X Process include an 850 lb melting capacity and 650 lb deposit weight. The pilot facility is able to handle ring sizes up to 30 in. in diameter, 16 in. in height, and 2.5 in. thick. Within one to two years, the Spraycast-X Process will offer a 4000 lb melting capacity, 3200 lb deposit weight and accommodate ring sizes up to 55 in. in diameter, 60 in. in height, and 5 in. thick.

In addition to reducing raw material requirements by 30%, the process cuts the number of ring-rolling steps. The fine microstructure produced by this process improves hot workability and provides a part closer to net shape than alternative forging processes. Machinability is improved by 25 to 35%. Other benefits include extremely rapid prototyping and a typical manufacturing cycle time of four to six weeks.

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

Prototype Noncontact Coating Thickness System

Many coatings require a nondestructive measure of their thickness as part of a quality control system. Traditional methods do not work in some cases. Difficult applications include soft coatings, uncured paints, metal coatings on alloys, ceramic and nonmetallic coatings on various substrates and thermal barrier coatings.

The Elcometer 385 uses a photothermal principle known as thermal wave interferometry to measure the thickness of a coating applied to a substrate. A thermal mix-match between the coating and the substrate is required to produce a detectable signal from the surface. An infrared wavelength solid state laser is used to generate the thermal wave.

Features of the Elcometer 385 include: noncontact measurement, calibration based on samples, computer-controlled system, menu-driven software, on-line capability as part of a coating system, and competitively priced solid-state laser source.

The measurement range for thermally sprayed coating applications is 100 to 150 mm (4 to 6 mil) for Ni and Ni alloys on supernimonic alloys, 50 to 450 mm (10 to 18 mil) for Ti on Co/Cr/Mo alloys, and 100 to 250 mm (4 to 10 mil) for Al/Mg on steel. The measurement time is <10 s, the characteristic beam spot size is 2 mm diam (approx.), and the accuracy ±5% of reading with a resolution of 1 mm or 0.1 mil.

Contact: Elcometer Inc., 1893 Rochester Industrial Dr., Rochester Hills, MI 48309; tel: 800/521-0635, 313/650-0500; fax: 313/650-0501.

Coatings Prevent Corrosion and Wear of Metal Parts

Self-lubricating surface treatments applied by General Magnaplate Corporation provide an extremely high level of protection against corrosion and wear and dramatically improve the performance reliability of all types of metal parts large and small.

These unique coatings are applied by a proprietary method that combines thermal spray coating technology with selected polymeric materials and/or dry-lubricants. They create a structurally integrated nonporous surface that provides superior permanent resistance against penetration of moisture or chemicals (e.g., chlorides, sulfites, bleaches) that could otherwise lead to corrosion of the metal substrate. The nonstick, contamination-free surfaces they create permit quick and easy washdowns—often requiring only water—and provide resistance to corrosion by caustic acids bleaches and other harsh sanitizers or detergents.

The coating's specifications include good resistance to salt spray as per ASTM B 117, wear resistance significantly superior to chrome plating or electroless nickel, dynamic COF as low as 0.12, and normal operating temperatures from –200 to +500 °F. Coatings can be applied to thicknesses required to repair worn parts or to meet specifications for new parts. They may be applied on all types of metal at any of Magnaplate's Materials Technology Centers in New Jersey, Texas, California, Wisconsin, and Ontario (Canada), or field-applied on-site to reduce equipment downtime.

Contact: Candida Aversenti, General Magnaplate, 1331 Route 1, Linden, NJ 07036; tel: 908/862-6200, 800/852-3301; fax: 908/862-6110; e-mail: info@magnaplate.com.

CERAC Technical Product Data on the Internet

CERAC product data sheets and quarterly technical newsletters are now available on the Internet. A visit to the "Technical Publications" page of the CERAC web site (www.cerac.com) reveals a wealth of information on their materials. While data on many types of inorganic chemicals can be found, the sheets focus on thin-film materials commonly used in the optical coating industry. As a complement to the on-line data sheets, the "Technical Publications" page also hosts current and recent issues of the popular quarterly publication *CERAC Coating Materials News.*

The data sheets provide technical overviews that include information ranging from refractive index and film properties to material behavior, evaporation parameters, physical properties, and more. Also listed are the stock forms and sizes generally available from CERAC.

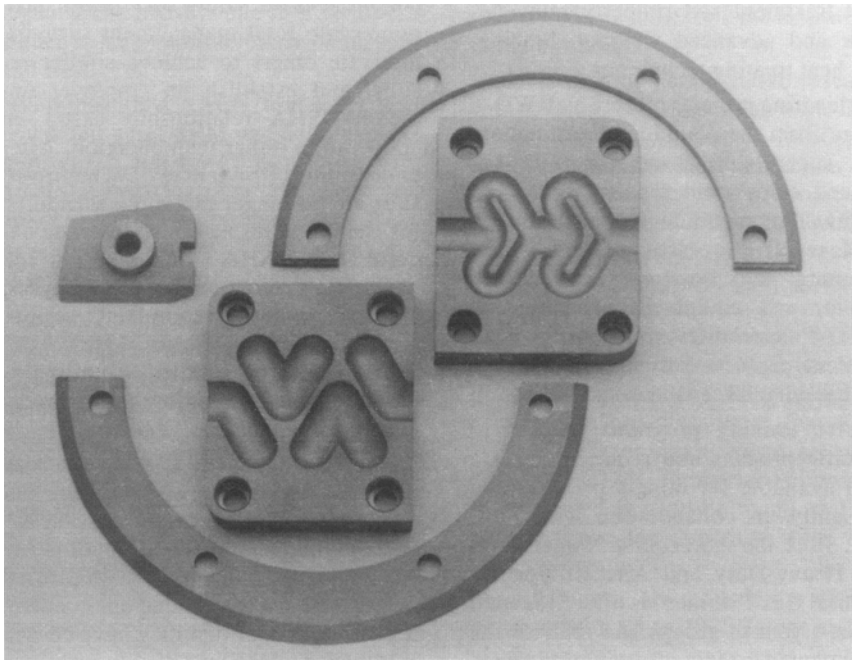
Each quarterly newsletter looks at emerging technologies in the coating industry and provides invaluable information on processing techniques and applications, materials and equipment. Leading industry professionals are regularly encouraged to share their expertise by contributing articles on new technologies.

Contact: Nora Bauer, Marketing Administrator CERAC, Inc.; tel: 414/289-9800; e-mail: marketing@cerac.com; URL: http://www.cerec.com.

New Benchtop Grinding/Lapping/ Polishing Machines From Struers

Struers has developed three new benchtop grinding/lapping/polishing machines, all designed to provide necessary functions to make them easy to operate. Quick exchange of discs adds to machine usage flexibility. LaboPol-21 is a two-disc, single-speed (300 rpm) machine, successor of the well-known Struers Knuth-Rotor. LaboPol-5 features variable speed (5 to 500 rpm), controlled by an electronic servo system that keeps speed constant regardless of load. LaboPol-1 is a single-speed (250 rpm) basic version.

If the number of specimens increases, or there are other reasons to automate fine grinding; and polishing, LaboPol machines can be automated by mounting a LaboForce Specimen Mover, available in two models. LaboForce-3 runs at a speed of 250 rpm with adjustable force between 5 and 40 N. LaboForce-1, the



Self-lubricating coatings to solve corrosion, wear and release problems on all types of metals parts such as these two-part urethane mixing chambers

LaboPol-21 grinding/lapping/polishing machines shown with LaboForce-3 specimen mover

basic specimen mover, runs at a speed of 8 rpm, with adjustable force between 2 and 20 N.

Contact: Chris Sopko, Marketing Manager, Struers, A Division of Radiometer America Inc., 810 Sharon Dr., Westlake, OH 44145-1598; tel: 800/321-5834; fax: 216/871-8188; http://www.struers.com.

News from Industry

German and American Firms Share Advanced Materials Technology

MRi, with headquarters in Lansdale, PA, recently signed a technology partnership and sharing arrangement with Euromat of Hückelhoven, Germany. Euromat, is a private technology transfer company formed for spinning off of developments from the Materials Institute at the University of Aachen and other German materials R&D organizations. It is bringing its growing group of new and existing, materials and related forming processes to market and is assisting companies to transfer concepts and new developments to industrial practice. This agreement links MRi, a three-year-old startup, which manufactures and applies numerous proprietary advanced joining and forming processes in the United States to the latest German materials technology as it is available for market.

In a joint interview, Dr. Smith, MRi's president, stated "The partnership will bring some of Europe's best and newest materials technology products in surface protection, braze joining, engineered powders, and related processing equipment to this country," while Dr. Ino Rass, managing director of Euromat, sees the collaboration with MRi as "a door to U.S. markets." Both felt "The partnership will greatly enhance the respective companies' penetration of international markets." The partners are now in the process of cross-training and exchanging materials and product knowledge in new brazes, fluxless air brazes for titanium and aluminum, powders, thin hard coatings, coated powders, and equipment for pressing ceramics.

Markets targeted for these products include heat exchanger brazing, wear and corrosion protection, friction reduction, simpler brazing of difficult to bond metal/ceramic materials and other high-performance surfacing applications.

For more information contact: Dr. R.W. Smith, Materials Resources International; tel: 215/393-5703; fax: 215/393-5704; e-mail: solution@mri-bluebell.com.

BWD Turbines Offers Services

BWD Turbines, Limited (BWD-T), is a high-technology group of experienced engineers specializing in providing independent engineering and processing support to the global gas turbine industry. For more than 20 years, benefits from these and other services have been realized by original equipment manufacturers, various component manufacturer and repair vendors, and end users such as international air carriers and industrial utility/cogeneration organizations.

The rapid development and application of aeroengine and industrial gas turbine high-temperature materials and processes has resulted in the need for trained and experienced metallurgical and processing support. BWD-T's expertise includes: component analysis, structural assessment and repair; material processing; protective coatings and stripping; component cleaning and inspection; reheat treatment and property rejuvenation; and advanced welding, brazing, and heat treating techniques.

Engineering projects offered by BWD-T range from the planning, coordination, and supervision associated with advanced component repair facilities to the evaluation and development of specific repair processes and strategies. Planning, parts flow analysis, facilities layout, and equipment selection are BWD-T specialties along with independent problem solving and component service life evaluations.

Course training programs tailored to specific projects and requirements are also available for on-site presentation. Presently, in collaboration with Prof. C.T. Sims, the short course "Superalloys for Heavy-Duty and Aircraft-type Industrial Gas Turbines" is offered several times a year to groups and individuals. This course provides information on superalloys and coatings, their processing, performance, and repair.

Contact: BWD Turbines, Ltd. 2412 Cascade Dr., Walnut Creek, CA 94598; tel: 510/938-4780; fax: 510/938-3068.

General Magnaplate Honored by OSHA

General Magnaplate Corporation was one of four Linden firms who received the first-in-the-nation Voluntary Protection Program (VPP) Merit Award for Smaller Businesses from the federal Occupational Safety and Health Administration (OSHA). National, state, and local dignitaries participated in an official flag raising and awards ceremony at which the companies were praised for their accomplishments in protecting their employees against work-related injuries. Until now, only major corporations participated in the VPP. Although there are currently more than 200 VPP sites in the nation, this Linden effort is the pilot program for smaller companies. It will now be extended to the rest of the country.

The VPP is designed to recognize outstanding achievement in incorporating comprehensive safety and health programs into total management systems, motivate others to achieve similar results, and establish an employer-employee-OSHA relationship based on cooperation rather than coercion. After undergoing a stringent review, approved sites are no longer randomly scheduled for standard inspections. Instead, experts from OSHA and the safety and health field program on-site analyses. However, employee complaints, serious accidents, or significant chemical releases would be handled according to more conventional enforcement procedures.

"General Magnaplate has always been proud of our record in protecting our employees against accident and illness," said Magnaplate President Candida Aversenti. "That's why we are so pleased that OSHA has recognized our concern. It's also an honor that they have chosen us to help lead the way in reducing some of the administrative burdens on small businesses."

Contact: Candida Aversenti, General Magnaplate, 1331 Route 1, Linden, NJ 07036; tel: 908/862-6200, 800/852-3301; fax: 908/862-6110; e-mail: info@magnaplate.com.

News from SYNCO Industries of India

SYNCO Industries has extensive activities in thermal spray, including the following areas:

- Manufacturing of wire, powder, and electric arc spray guns
- Manufacturing of thermal spray powders and wires
- Manufacturing of air operated and airless blasting/shot-peening machines, blast room, acoustic chamber, bag filters, cyclones, dry and wet spray booth, and other such machines as per the customer design requirements
- Site job for corrosion/wear protection based on thermal spray processes
- Reclamation/OE coatings based on thermal spray processes
- New coatings, spray process and consumables design and development

Contact: Dr. D. Kumar, Director, 16-A (iii) Heavy Industrial Area, Jodhpur-342 003 India; tel: 41571-41671; fax: 91-291-42557.

News from National Laboratories

Old Paint Becomes New Lead SRM at NIST

A small loss for Akron, OH, is a big gain for chemists monitoring lead in the environment. NIST's newest Standard Reference Material (SRM) for measuring lead in paint was made from paint scraped from old homes in Akron. The paint, mostly from homes built before 1945, contains high levels of lead and therefore was an ideal choice to become NIST's highest level lead in paint SRM. The paint, ground to a very fine powder, contains 10% Pb by mass.

Environmental chemists will use the new SRM to calibrate their instruments and verify the accuracy of their analytical methods. Developed in conjunction with the Environmental Protection Agency, the SRM is one in a series designed to help monitor lead in paint, soil, and dust.

NIST also sells a very low level lead powdered paint SRM and soon expects to offer 0.5 and 4% Pb powdered paint SRMs. Contact: SRM Program; tel: 301/975-6776. (Reprinted from *NIST Research for Industry,* "Technology at a Glance," Fall 1996)

HTML Researchers Study Brake Judder

Ralph Dinwiddie and his colleagues in the High Temperature Materials Laboratory (HTML) at Oak Ridge National Laboratory (ORNL) are working with Ford Motor Company to understand some of the physical phenomena associated with brake "judder." This $3-billion warranty problem causes disc brakes to develop a vibration that transfers to the steering wheel and, ultimately, to the driver's wrists.

A model has been developed at the University of Michigan to describe formation of the localized instabilities—hot spots—that form when brakes are applied at high speeds. However, Dinwiddie is the first to image the hot spots, using an infrared camera with an interface circuitry he developed to perform what he calls "synchronized time-lapse thermography." These localized expansions of the metal in the rotor produce raised areas that drag a little more aggressively against the rotor to cause the not-well-understood condition of judder.

ORNL Metals and Ceramics (M&C) Division researchers use state-of-the-art facilities and instruments that have made HTML one of the most successful user facilities in the DOE lab system. In this case, Dinwiddie took the instrument to the customer.

Under a previous cooperative research and development agreement with Ford Motor Company, fellow M&C researcher Peter Blau had studied how different environments, like pad materials or even the weather, affect the frictional performance of brake pads, as well as how the surfaces of pad materials change when the brakes are applied. Blau recommended Dinwiddie's infrared camera when a Ford engineer mentioned the hot-spot problem, but the camera was not portable at that time. HTML Director Arvid Pasto set up a "reverse" HTML Industrial Fellowship that allowed Dinwiddie to go to Ford and configure the camera to work with a laptop computer.

Manufacturers are constantly experimenting with up to 20 different materials that make up the brake pads. Finding the best balance between long wear and less squeal has been a trial-and-error process for the auto industry. According to Dinwiddie, Ford is initiating a study from the basic principles of thermoplastic instabilities, the cause of what is happening in the rotors. "By visualizing the hot spots and measuring their temperatures," he says, "we can use this [method] to make and tune models to understand the phenomenon. It will eventually help design engineers build better brakes." (Reprinted from *Ceramic Technology Newsletter,* No. 51, 1996)

Modified Intermetallic Has High-Temperature Potential

This alloy forms two different protective oxide coats in two different temperature ranges. The substitution of a large proportion of molybdenum for the chromium in chromium silicide (Cr_3Si) yields an alloy with increased resistance to oxidation, erosion, and creep. This improved high-temperature alloy can potentially be used, for example, on blades and vanes exposed to hot, flowing, oxidizing gases in turbine engines. Other possible applications include chemically inert extrusion dies in the food, glass, and polymer-processing industries, where resistance to erosion and corrosion are important.

By itself, the intermetallic compound Cr_3Si exhibits poor resistance due to oxidation at temperatures above 1150 °C. This is partly because chromium oxidizes faster than silicon does. The silicon component oxidizes too slowly to form a protective SiO_2 coat.

The present, improved alloy is $Cr_{40}Mo_{30}Si_{30}$. It was chosen after preliminary experiments as the best of a number of candidate alloys that were synthesized by arc-melting mixtures of

various proportions of Cr, Mo, and Si. The microstructure of this alloy features two phases—Cr_3Si and Mo_5Si_3—that form two protective oxides in different temperature ranges: below 1200 °C, a stable layer of Cr_2O_3 forms on the surface of the alloy; above 1200 °C, a stable layer of SiO_2 forms.

The addition of molybdenum decreases the melting point of the alloy only slightly, to about 1700 °C. At the same time, it increases the creep resistance to about that of $MoSi_2$ reinforced with silicon carbide particles, but without making the alloy highly susceptible to low-temperature oxidative disintegration unlike $MoSi_2$. The mass density alloy is less than that of superalloys. The alloy is brittle, but the addition of partially stabilized zirconia or another suitable agent may provide a measure of toughening.

This work was performed done by Sal V. Raj of NASA Lewis Research Center. Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Lewis Research Center; tel: 216/433-2320. Refer to LEW-75697. (Reprinted from *NASA Tech Briefs,* Vol 20 (No. 10), 1996, p 78, 80)

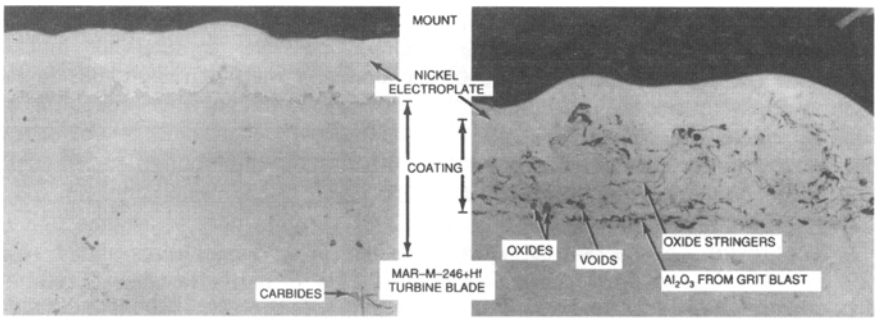
Improved Plasma Spraying Thermal Barrier Coating Technique

A vacuum plasma spraying process (more precisely, a low-pressure argon plasma-spraying process) applies improved thermal barrier coatings to turbine blades. A coating of this type (see figure) comprises (1) a thermal barrier layer of 92 wt% ZrO_2 mixed with 8 wt% Y_2O_3 on top of (2) a bonding layer of NiCrAlY. These thermal barrier coatings have been developed for the turbine blades of the high-pressure fuel turbopump of the main engine of the space shuttle. They could also be used to prolong the service lives of turbine blades and other thermally stressed components in terrestrial gas turbines, jet engines, and automotive engines.

Prior to the development of the present vacuum plasma spraying process, the thermal barrier coatings in the space shuttle application were applied in an air plasma spraying process. The coatings were observed to spall after limited numbers of engine start/stop thermal transients. Coatings applied by the vacuum plasma spraying process endured five times as many cycles. The early spalling in the case of the air plasma sprayed coatings has been attributed to the formation of oxides at the surfaces of the blades and throughout the NiCrAlY layers. The oxides are brittle and weak, leading to premature failure of entire coatings.

Such oxidation does not occur in the vacuum plasma spraying process. Because the powders used in the vacuum plasma spray process are finer than those used in the air plasma spraying process, the vacuum plasma sprayed coatings are less rough. As a result, turbine efficiencies are improved and rates of heat transfer to the coated turbine blades are reduced. The vacuum plasma spraying process also enables the use of preheated substrates (the turbine blades) and of negative-transfer-arc cleaning of the substrates prior to deposition to achieve dense, strongly bonded coatings (see figure).

This work was done by Richard Holmes and Frank Zimmerman of Marshall Space Flight Center and Timothy N. McKechnie of Plasma Processes, Inc. Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center; tel: 205/544-0021. Refer to MFS-30081. (Reprinted from *NASA Tech Briefs,* Vol 20 (No. 10, 1996, p 97)



This photomicrograph shows a cross section of a thermal barrier coating that was (a) vacuum plasma sprayed onto a turbine blade made of MAR-M246+Hf alloy and (b) air plasma sprayed on the same alloy.

Errors in Universal Hardness Testing

The following is a summary of a paper written by Jan Olaf and Bernd Ritter based on research done at the Fraunhofer Institute for Material Mechanics in Freiburg, Germany.

Microhardness testing methods are often used to characterize the mechanical properties of layered composite materials. This measurement technique is becoming increasingly important, especially for very thin layers. "Universal" surface hardness tests utilize very shallow indentations to determine the hardness of thin layers on substrates. Since these indentations depths are so small, the measured hardness values are affected by parameters such as indenter geometry, load characteristics, testing conditions, and material microstructure. The method of finite element analysis (FEA) offers an efficient method to study the influences of particular parameters on measured hardness values. Besides indentation depth and remaining indentation size, which can be obtained experimentally, the FEA simulation makes possible the evaluation of the total deformation and the internal stress in the layer, the substrate, and the indenter for any loading condition. This leads to a deeper understanding of the indentation process. Of significant importance was the finding that the properties of the substrate affect the measured hardness values, even in case of the smallest indentation depths.

Modern materials like composites made of a surface layer and substrate must satisfy an incredible range of different volume and surface requirements. The hardness measurement plays a more significant role in the characterization of the mechanical properties of such systems. "Universal" hardness testing utilizes an active test load to generate a

force versus indentation depth curve. For a particular indenter geometry, the hardness may be calculated from the force versus indentation curve. Universal hardness testing has the advantage over classical tests, such as Vickers, Berkovich, and Knoop, in that it analyses and evaluates even very shallow indentations, enabling hardness measurements on very thin layers. Under ideal conditions, the universal surface hardness measurements should be independent of test force, but due to deviations from perfect indenter geometry, the Kick's law of similarity is no longer valid for small indentation depths, making the measurements load-dependent. Furthermore, in the case of a small indentation, other parameters may introduce additional errors in the measured values. These parameters may be machine-specific, such as friction, null point position, and machine stiffness or may be specimen-related, such as preparation, surface effects, and microstructure. The finite element analysis method offers a way of studying the individual parameter influences on the measured hardness values since the parameters can be varied independently of one another in the simulation. This creates the possibility of completely separating the dependence on machine and specimen parameters.

The basic dependence of the load-indentation depth curve on geometric parameters may satisfactorily be studied by simulation of a homogenous test material. Simple calculations are used to evaluate relative changes in hardness values corresponding to changes in each of these geometric parameters. The relative change in hardness value is expressed as the difference between the hardness measured for the actual indenter geometry and the hardness as would be obtained under conditions of ideal indenter geometry divided by the measured value. Hardness values calculated by FEA under applied test loads show that there is a constant, load- independent change in hardness measurement due to changes in the solid angle of a conical indenter. The small variations in calculated hardness values for indentation depths under 0.1 μm can be numerically resolved by using a finer FEA mesh.

Certain effects due to the geometry of the four-sided Vickers pyramid can, as opposed to the three-sided Berkovich pyramid or a cone, affect hardness measurements at small indentation depths. The effect of the side length can be calculated from the geometry and the resulting increase in hardness can be corrected.

There are different approaches to taking tip rounding into account. Tip rounding may be modeled a number of different ways, ranging from a finite small radius between sides of the pyramid, to a spherical tip, to small radii between opposite corners of the indenter. It was found that the geometry-specific increase in measured hardness values at smaller indentation depths can be completely corrected if the exact geometry of the indenter tip is known. Although the given equations are valid in the finite element analysis, these models can serve only as rough approximations of the exact indenter geometry corrections. In reality, a test diamond indenter exhibits a variety of geometric deviations, requiring a series of corrections. It was noted that the effects of rounding of the edges were negligible in comparison to the effects of tip rounding.

Original source: *Materialprofung,* Vol 34 (No. 5), 1992, p 143-146. Reprinted from *MIAC Newsletter,* Vol 6 (No. 4), Sept 1996, p 4-5. Article authored by Eric Helton, MIAC Staff, Metal Information Analysis Center, Purdue University, 2595 Yeager Rd., West Lafayette, IN 47906-1398; tel: 317/494-9393; fax: 317/496-1175; URL: http://cindas. ecn. purdue.edu.miac/.

Low-Bid Rejection Requires Justification

In highway-construction bidding, rarely does a disappointed bidder overturn a decision by state or local government officials because to do so generally requires a finding that the officials exercised their discretion arbitrarily. While, in general, state agencies are required to award public works contracts to the lowest responsible bidder, that requirement is not absolute.

In most states, the DOT can award the contract to another bidder in cases where it is determined that this action will better serve the state's interests, provided that the DOT sets down its reasons for the award to a contractor other than the lowest responsible bidder, and clearly describes how the state's interest is better served.

A Delaware case, Harmony Construction, Inc. v. State of Delaware Department of Transportation, 668 A.2d 746 (1995), illustrates a situation where the court determined that a DOT's decision not to award a highway construction contract to the lowest bidder was arbitrary and capricious. In Harmony, the contractor was found to be the lowest responsible bidder on Contract 03, a highway-construction project. It was also the lowest responsible bidder on four other Delaware DOT (DelDOT) state highway projects. DelDOT had concerns regarding Harmony's ability to perform all five contracts satisfactorily and directed Harmony to provide—in writing—a work schedule illustrating how it would proceed to perform all five contracts if they were awarded.

The court decided that DelDOT made up the rules as they went along, never told Harmony what the rules were, and only after the game was over was Harmony told that it had "flunked." This case is obviously unique. However, it points out that when the low bid is rejected, the state or local government should have a good reason for the rejection. (Reprinted, in part, from *Roads & Bridges,* Vol 24 (No. 9), Sept 1996, p 8. Article by Cordell Parvin, who is a shareholder in the law firm of Leonard, Hurt & Parvin, PC., which has offices in Dallas, Houston, and Austin, TX; Washington, DC; and Richmond, VA)

Survey of Industrial Research and Development

"1994 Company Funding of U.S. Industrial R&D Rises as Federal Support Continues to Decline," by Raymond M. Wolfe

The National Science Foundation's Survey of Industrial Research and Development for 1994 shows that firms spent $119.6 billion on research and development (R&D) in the United States, 2% more than during 1993. Company funding continued to increase, from $94.6 billion to $97.1 billion, as it has each year since 1953. Federal funding decreased from $22.8 billion to $22.5 billion, continuing a trend that began in 1988. After adjusting for inflation, company-funded R&D rose 0.6% and federally funded R&D fell 3.5%.

Although the amount spent for industrial R&D during 1994 increased compared with 1993, total R&D measured in constant dollars decreased 0.2%. This downward trend, which began in 1992, is only the second since 1953. The first occurred in the early 1970s when total R&D measured in constant dollars began falling and did not regain its 1969 level until 1978. The remainder of this data brief will focus on the sources of industrial R&D support and will present information on the size and employment of R&D performing firms.

Among manufacturing industry groups, firms in transportation equipment industries, particularly those that build aircraft and missiles, received the largest share of federal support during 1994. Although down 2% from 1993 levels, these firms received $10 billion or 46% of the government's support of industrial R&D. Makers of professional and scientific instruments and electrical equipment ranked second and third. Firms in those industries performed $3 billion and $2 billion of federal R&D, respectively, and accounted for 23% of total federal R&D. Firms in nonmanufacturing industries as a group received $5 billion, another 23% share of total federal support. Most of this support went to computer-related service firms and research, development, and testing firms. Manufacturers of machinery including computers, petroleum extractors and refiners, drug and medicine makers, and other manufacturers received the remaining 8%, performing $2 billion of the total federal R&D.

While the federal government's share of support to most industry groups declined during 1994, the amount firms contributed to their own R&D efforts continued to grow. Overall, nonmanufacturing firms as a group comprised approximately 25% of the total industrial R&D performance. These firms ranked first among performers of company-funded R&D, contributing $24 billion during 1994. In terms of dollars spent, among the largest nonmanufacturing performers were computer-related service firms, which comprised $6 billion, and research, development, and testing firms, at $2 billion. Among manufacturing industries, firms in transportation equipment, especially automobile makers, performed the largest amount of R&D during 1994, at $18 billion, with chemical manufacturers including makers of drugs and medicines ranking a close second, at $17 billion. Manufacturers of electrical equipment, including electronic and communication components, performed $14 billion of R&D. Together these four industry groups accounted for two-thirds of total company-funded R&D performed by manufacturers. Makers of professional and scientific instruments, machinery, petroleum extractors and refiners, and other manufacturers performed the remaining third.

Performance of R&D by the smallest firms, those with less than 500 employees, declined 4% during 1994 compared with 1993. For this group, federally sponsored R&D declined 28%. For larger firms, those with 500 to 5000 employees, overall R&D increased 22%; however, federal R&D for this group declined 3%. For the largest firms, those with more than 5000 employees, company-funded R&D increased 6%, but federal R&D declined by the same percentage.

In addition to collecting information on the amount of R&D, the Survey of Industrial R&D also gathers information on the number of scientists and engineers who perform R&D. The number of full-time equivalent (FTE) scientists and engineers engaged in R&D activities (those assigned full-time plus a prorated number of employees working part-time on R&D) in 1994 was 758,800 for all industries—561,400 in manufacturing and 197,400 in nonmanufacturing industries. Compared with 1993, the number of FTE scientists and engineers dropped 0.7%. It fell 1.2% in manufacturing industries and rose 0.5% in nonmanufacturing industries.

For free printed copies of Data Briefs or to be placed on the mailing list for a free copy of the annual report, write to the National Science Foundation, Division of Science Resources Studies, Publications Management Group, 4201 Wilson Blvd., Suite 965, Arlington, VA 22230; tel: 703/306-1773; e-mail: srspubs @nsf.gov.

Venture Business Laboratories at Japanese National Universities

Summary

To promote creative R&D that could spur venture business and generate new industry as well as broaden the background and experience of professional staff, the first supplementary budget for JFY1995 funded 11 national universities in science and engineering and the second supplemental budget for JFY1995 funded 10 universities in science and engineering in order to establish venture business laboratories.

Objectives

- To implement R&D projects in basic technologies that will advance Japanese industries in the future, including semiconductors, multimedia/ computers, and micro machines, at graduate schools in science and engineering at national universities.
- To provide graduate students with advanced training to help develop creative and innovative ideas and to instill within these students a venture spirit and enhanced professional abilities.
- To enable venture business to be joined with education and research facilities in order to implement creative R&D projects at graduate schools in science and engineering at national universities.

Important Features

- Relevance: To be a practical and relevant project promoting venture-type R&D in order to develop new industries and provide professional training.

- Creativity: To place an increased importance on innovation and creativity by graduate students and young researchers.
- Comprehensiveness: To be a comprehensive and interdisciplinary project that crosses boundaries among special fields.
- Openness: To be a project that promotes exchanges of researchers with other countries and with the industrial sector.

The total budget for the Japanese financial year (JFY) in 1995 was 25.6 billion yen. In 1996, based on the venture business laboratories established in the JFY1995 budget, the budget aims at enabling Ph.D. holders to be involved in the research projects for a fixed term and for faculty to receive funds for research and for identifying international R&D trends. Total funds to achieve this were: research funds 0.40 billion; funds for inviting foreign researchers 1.79 billion; funds for activities outside laboratories 5.37 billion; and funds for hiring Ph.D. holders for a fixed term 3.79 billion (a total of 13.37 billion yen).

Thermal Spray Society News

TSS and ITSC'98 Reach Cooperative Agreement

The ASM Thermal Spray Society (TSS) representatives and the French National Organizing Committee (NOC) have reached an agreement that will enable TSS to assist the NOC with ITSC'98 organizing efforts. As part of the agreement, TSS will publish the ITSC call for papers and assist with event promotion and U.S. organizing efforts. TSS will also publish the ITSC conference proceedings and serve as a cosponsor of the ITSC Exposition.

In addition, to encourage participation in ITSC'98, no joint TSS and DVS activities are planned in the United States in 1998. Any U.S. company wishing to exhibit at ITSC'98 should contact Jan DiRosa, TSS Exhibitor Marketing Specialist; tel: 216/338-1733; fax: 216/338-4634; e-mail: jdirosa@po.asm-intl.org; http://www.asmintl.org/.

TSS and ITSA Merge Newsletters; More Joint Activities To Come

To better serve the thermal spray community, representatives of the TSS and the International Thermal Spray Association (ITSA) have discussed joint projects that will make the most of limited resources and eliminate duplication of effort.

The first step taken by the two organizations will be to merge the TSS publication, Thermal Spray News with the ITSA publication, *Spraytime,* starting in 1997. The merger will increase the distribution, broaden the scope, and increase the appeal of a single publication—one that will become a dedicated and representative voice of the thermal spray community.

The best features of each newsletter will be preserved and new features may be added, including more extensive product and company advertising sections. It may also carry more applications-oriented news, which would make it a useful piece for promoting thermal spray technology.

The new publication, as yet unnamed, will have a joint TSS/ITSA editorial board and will have a professional editor responsible for design, advertisements, content, and distribution.

More TSS/ITSA News

According to TSS Past President Ron Smith and ITSA Chairman Jimmy Walker, both organizations are working toward joint programs that bring more value to the thermal spray community. One such example is the creation of a Thermal Spray Speakers Directory, currently being compiled by TSS member Richard Mason of AMETEK, Chairman of the TSS Industry Development Committee.

Other activities that support the industrial application of thermal spray technology are also being discussed, including:

- Thermal spray technology marketing and promotion
- Certification and training (shop and operator)
- Industry and market data
- Regulatory representation

A joint TSS and ITSA strategic-planning committee has been appointed to assess areas where the thermal spray community will benefit from joint programs. Future developments will be carried in the new TSS and ITSA joint publication.

People in the News

Frank Worzala

Frank Worzala, 62, Madison, WI, died 15 August 1996. A University of Wisconsin, Madison, professor since 1967, he had retired last summer. For the past five years, he had chaired the Department of Materials Science and Engineering.

He specialized in plasma spray coatings and other technologies to improve the surface properties of materials. He had active partnerships with Wisconsin companies such as TREK Bicycle Corporation of Waterloo, Fisher-Barton Corporation of Watertown, and Thermal Spray Technologies of Sun Prairie.

Thermal Spray Technologies, which opened in 1993, was a spin-off company conceived through the work of Worzala and others in materials science. Worzala and colleagues also had projects with TREK to improve the strength of mountain bike rims and frames. At his retirement party this past spring, students

presented Worzala with a mountain bike they had custom designed with equipment from the college, using many of the techniques Worzala had taught them.

In 1986, he earned the College of Engineering's Ragnar E. Onstad Service to Society Award, given annually to someone who shows "unselfish commitment to society at the community, church, university, state, and national levels." He became a member of ASM in 1984.

Gilbert N. Jurak

Gilbert N. Jurak, one-third owner of Plasma Coating Corporation, passed away suddenly on 10 November 1996. He was the Corporation Secretary-Treasurer as well as the Quality Control Manager. Plasma Coating Corporation has been a member of the International Thermal Spray Association since April 1977 (then known as MSC). He leaves his wife, Tommye, as well as his son, Geoffrey, two daughters, Lynda and Tommye, and three granddaughters and a grandson.

In lieu of flowers, donations may be made to: The Gilbert Jurak Memorial Fund, Long Beach Youth Boosters, P.O. Box 92741, Long Beach, CA 90809, or NRA Whittington Center, P.O. Box 700, Raton, NM 87740.

T.R.B. (Tom) Watson

T.R.B. (Tom) Watson, professional engineer, former president of the National Association of Corrosion Engineers International (NACE) and founder of Corrosion Service Ltd., Toronto, died 2 May 1996 after a brief illness. He was 80. A NACE member for 49 years, Watson served on the Board of Directors, representing the Canadian Region, from 1959 to 1962. He was President of NACE International in 1964 to 1965. Prior to that, he held many sectional and regional positions, including chairman of the Canadian Region in 1956, and was a member of the Executive Committee.

For many years, Watson was a "hands-on" corrosion engineer. He walked pipelines, climbed water towers, scrambled over paper machines, dug holes, attached lead wires, and conducted field tasks now done by technicians. "He had an inquiring mind and would research subjects until he thoroughly understood them," says former NACE President Harry Webster. "Throughout his working career he identified himself as a corrosion engineer, a title of which he was truly proud."

At NACE conferences and Sea Horse Institute conventions, Watson often joined friends and acquaintances in the "Canadian Suite" after completing the day's business. Watson was a gifted writer, author of *Why Metals Corrode* (an easy introduction to corrosion) and other books, many technical papers, and poetry. Perhaps his best known writing is "Rust's a Must" (reprinted from *Materials Performance,* Sept 1996).

Rust's a Must

by Tom Watson

Mighty ships upon the ocean
Suffer from severe corrosion;
Even those that stay at dockside
Are rapidly becoming oxide.
Alas, that piling in the sea
Is mostly Fe_2O_3
And when the ocean meets the shore,
You'll find there's Fe_3O_4.
'Cause when the wind is salt and gusty
Things are getting awful rusty.
We can measure it, we can test it;
We can halt it or arrest it;
We can gather it and weight it;
We can coat it, we can spray it;
We examine and dissect it;
We cathodically protect it.
We can pick it up and drop it
But heaven knows, we'll never stop it.
So here's to rust: No doubt about it,
Most of us would starve without it.

Ernie Long Retires from ORNL

Ernest L. Long, Jr., who was instrumental in developing the industry assessment and program plan for the Ceramic Technology Project, retired 30 September 1996. Ernie, as everyone knows him, also served as task leader for Coatings and Tribology since the beginning of the program and was Technical Monitor for programs in powder synthesis and innovative processing technology.

In addition, Ernie was the *Ceramic Technology Newsletter*'s technical advisor and editor, and, in keeping with his dedication to the newsletter and the project's research, Ernie planned issue No. 51 before he left.

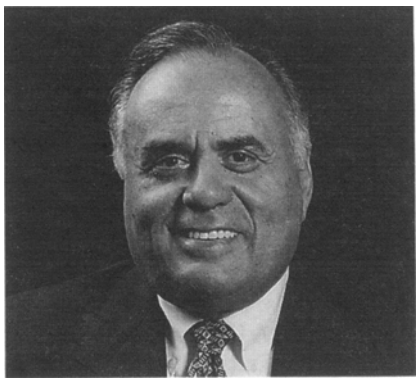
Ernie's employment with Oak Ridge National Laboratory (ORNL) and the Metals and Ceramics Division (M&C) spanned 42 years, beginning in the Metallography Group where he later served as Group Leader of the Remote Metallography Group for a number of years. He later became a member of the M&C High Temperature Gas Cooled Reactor Team, during which time he was assigned to a German research laboratory (KFA Jülich) for a year. Following that assignment, he became a member of the DOE/ORNL Synfuels Team.

In 1982 to 1983, Ernie was one of four people who spent the better part of a year traveling around the country developing a consensus program plan for the DOE Ceramic Technology Project.

For the past 13 years, he has been a task leader for the Ceramic Technology Project, serving also as manager of the DOE Office of Industrial Technologies Materials Program in M&C for six years. In May, Ernie returned to his roots at M&C after being appointed group leader of M&C's Metallography and Photographic Imaging Group of the High Temperature Materials Section. Realizing the importance of using the latest technology for communication, Ernie directed the development of M&C's presence on the World Wide Web during his last year. (Reprinted from *Ceramic Technology Newsletter,* No. 51, 1996)

Vincent Meringolo Named Product Manager by General Magnaplate Corporation

Vincent Meringolo has joined General Magnaplate Corporation and has been named Product Manager—Plasmadize, according to an announcement by Magnaplate President Candida Aversenti. Mr. Meringolo will provide new, in-house expertise for the expansion of



Vincent Meringolo, Product Manager—Plasmadize, General Magnaplate Corporation

Magnaplate's thermal spray coating product line, especially for those applications requiring superior mold release properties, low coefficients of friction, and/or FDA/USDA compliance.

Mr. Meringolo received his B.S. in metallurgical engineering from Polytechnic Institute of Brooklyn and his M.B.A. in marketing from Hofstra University. Before joining Magnaplate he served as Vice President Marketing for Sulzer Metco. He is a member of ASM International and the Thermal Spray Society. A resident of Smithtown, NY, Mr. Meringolo and his wife Stacy have two sons and a daughter.

According to Mrs. Aversenti, "Vince's extensive experience in the field of thermal spray deposition will enable Magnaplate to grow our Plasmadize line of coatings even faster and permit us to provide even more options and better service to our customers."

Langer joins IBIS

IBIS Associates, Inc. announced today the appointment of Edward L. Langer as Principal of the Wellesley-based business development and technology strategy consulting firm. Langer has retired as Managing Director of ASM International, the materials information society, and joined IBIS on 1 January 1997.

Dr. John V. Busch, President and founder of IBIS states, "Ed Langer brings IBIS rich and broad experience in materials and processes and related industries. During his 30 years with ASM he has been immersed in all segments of the industry and has developed a vast network of contacts among the leaders of the industry worldwide. Ed's expertise and relationships will benefit our clients."

Langer, as ASM Managing Director for the past 13 years, successfully led the Society through the restructuring of the world materials and manufacturing industries. ASM with 45,000 members worldwide is the leading source of information and education on materials and processes technology. Langer holds bachelor's and master's degrees from John Carroll University and did extensive graduate work in chemistry and metallurgy at Ohio and Cleveland State Universities. He serves on a number of professional association, civic, and corporate boards.

IBIS Associates is a management consulting group founded in 1987 out of MIT's Materials Systems Laboratory. IBIS specializes in working with materials and manufacturing oriented organizations to make business development and technology strategy recommendations. Specific methodologies include cost modeling, cost-performance tradeoff assessment, quantitative market characterization, value chain analysis, and dynamic business simulation. Fifteen highly trained and experienced professionals form the IBIS team.

Berndt, Kammer Named Fellows of ASM

Two ASM Thermal Spray Society (TSS) Board members were installed as members of the 1996 Class of Fellows of ASM International.

Prof. Christopher C. Berndt, Department of Materials Science and Engineering, The Center for Thermal Spray Research, State University of New York at Stony Brook, was cited "for outstanding contributions to thermal spray science and technology and for significantly advancing our understanding of mechanical failure mechanisms of thermal spray coatings."

Dr. Paul A. Kammer, Senior Executive, Eutectic + Castolin Group, Lausanne, Switzerland, was cited "for contributions to the advancement of the technology and utilization of thermal spraying and materials joining through the development and commercialization of innovative materials, consumables and equipment."

ASM established the honor of Fellow (FASM) to recognize members for distinguished contributions in the field of materials science and engineering. Fellows represent a broadly based forum of technical and professional leaders serving as advisors to the Society.