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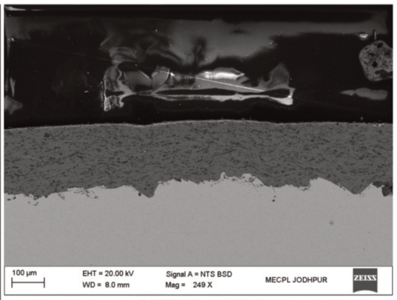
SPRAYTIME

AWS INTERNATIONAL THERMAL SPRAY ASSOCIATION

Cold Spray Today

PUBLISHED BY THE INTERNATIONAL THERMAL SPRAY ASSOCIATION,
A STANDING COMMITTEE OF THE AMERICAN WELDING SOCIETY

INNOVATIVE CERAMIC COATING

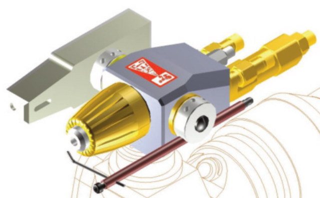


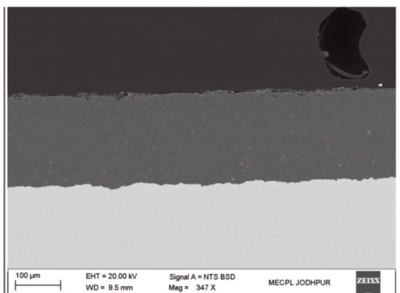
Al2O3-TiO2

POROSITY %	1.0-2.0
HARDNESS $HV_{0.3}$	700-850
ADHESION STRENGTH(MPa)	63.81
AS-SPRAYED Ra (µm)	2.0-4.0

- DENSE COATING
- GOOD ADHESION
- FLASH COAT / THIN COAT
- EXCELS PLASMA COATING
- LOW ROUGHNESS AS SPRAYED

CERAJET® GUN
(Patent Applied)



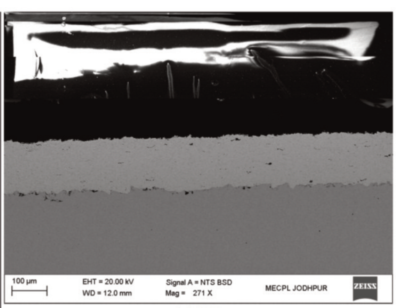


Al2O3

POROSITY %	2.0-3.0
HARDNESS $HV_{0.3}$	750-850
ADHESION STRENGTH(MPa)	61.23
AS-SPRAYED Ra (µm)	3.5-4.0

Control Panel, HV-3100

- Massflow controlled
- Auto Ignition
- Built in powder feeder.



YSZ

POROSITY %	1.0-2.0
HARDNESS $HV_{0.3}$	550-700
ADHESION STRENGTH(MPa)	39.29
AS-SPRAYED Ra (µm)	2.0-4.0

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On the cover: The top photo features a camouflaged version of the SPEE3D cold spray system, which is meant for military use in remote locations. (Photo courtesy of SPEE3D.) The middle photo shows how this system can be used manually. (Photo courtesy of Ellsworth Air Force Base.) The bottom photo shows VRC Metal System's Raptor cold spray system. (Photo courtesy of VRC Metal Systems.)

Features

Departments

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By Victor K. Champagne Jr. and Aaron Birt

CSAT 2021: Manufacturing at the Point of Need

On June 22 and 23, the Cold Spray Action Team (CSAT) welcomed more than 630 attendees from across the globe to CSAT 2021, which was held both virtually and in-person — Fig. 1. The event is a combination of a conference, workshop, technical meeting, and strategic planning session all rolled into one. It is a forum for discussion and debate and is backed by a program suited for most everyone involved in the area of cold spray. The conference continues to be the world's largest gathering within the cold spray community.

The brainchild of Victor K. Champagne Jr., who continues to serve as executive director, CSAT was conceived more than 11 years ago to help bring together people from all facets of the cold spray sector — from researchers and equipment manufacturers to suppliers of feedstock powders — to support industries and users of the technology. Champagne recognized a need to accelerate the advancement of cold spray across the industrial base. Here are some highlights from the event.

Award Recognition

Champagne and Associate Executive Director Aaron Birt have been expanding CSAT to increase its global appeal. The CSAT advisory board now has two new members from Australia.

Julio Villafuerte, also a newly elected board member, traveled from Colombia to accept a special achievement award for his dedication toward the advancement of cold spray — Fig. 2A. Danielle Cote, an assistant professor at Worcester Polytechnic Institute, Worcester, Mass., was also recognized for her research accomplishments toward advanced feedstock powders — Fig. 2B.

Champagne emphasized the important mission of CSAT as he stated, "Cold spray will move into the world marketplace much more quickly and efficiently if people are educated about the attributes and limitations of the technology. The research community, including industry, academia, and the government, needs to work together to share as much information as possible [and] develop the knowledge base and engineering data to match the technology to the best applications."

Manufacturing at the Point of Need

The theme for this year's CSAT was manufacturing at the point of need. It attracted many speakers who introduced the latest innovations addressing this important topic. As stated by Ryan D. McCarthy, the former U.S. Secretary of the Army, regarding the introduction of a new policy on advanced manufacturing, "Advanced manufacturing will fundamentally change the way the Army designs, delivers, produces, and sustains materiel capabilities."

We know that cold spray has been used to address the readiness and sustainment challenges caused by parts obsolescence, diminishing sources of supply, and sustained operations in harsh environments by providing dimensional restoration and wear- and corrosion-resistant coatings, but there has been an aggressive pursuit to adapt cold spray for 3D printing of parts.

"Advanced manufacturing enhances the supply chain and sustainment efforts, both forward in the field and in our maintenance depots, enabling soldiers to quickly manufacture critical parts and supplies at the point of need," said General Gus Perna, the former commanding general of U.S. Army Materiel Command (Ref. 1).

Cold Spray Technology

A highlight of the CSAT conference was the presentation of SPEE3D's cold spray system (see cover page). Using its patented cold spray additive manufacturing technology, SPEE3D provided onsite production of parts by cold spray and addressed the following three critical issues related to manufacturing at the point of need:

1. **Obsolescence** — Printing on-demand metal parts that would require significant time and expense to procure via existing supply chains. The company's cold spray systems have been demonstrated to make a part onsite in minutes or hours (vs. weeks or months) and get a key asset back in operation.
2. **Customization** — With the SPEE3D printers' built-in software that's easy to design and simulate, operators can create customized parts for applications in the field — including hinges, battery terminals, bilge pumps, camlock fittings, brackets, covers, heat sinks, flanges — and other parts in severe field conditions.

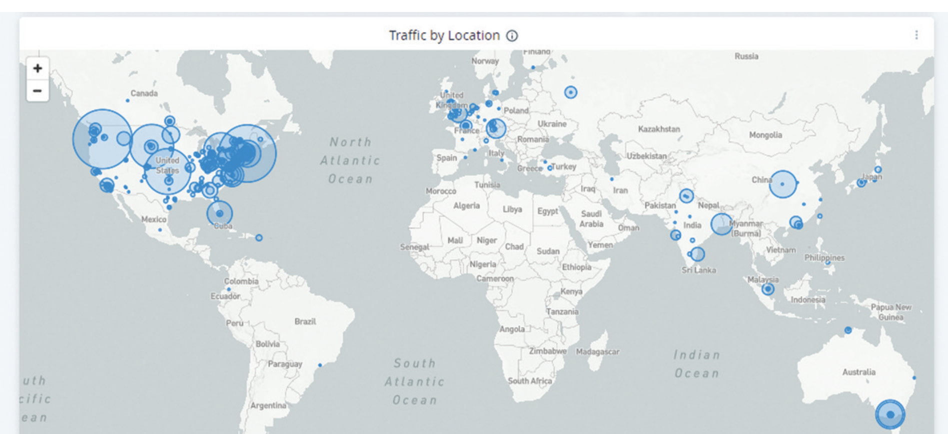

Fig. 1 — CSAT attendees according to geographical location.

3. **Logistics** — Solving logistical issues in defense, oil and gas, maritime, and mining operations through direct or indirect involvement by providing onsite personnel for installation, maintenance, and design through finished part services.

The company's cold spray system has had a series of successful demonstrations and joint projects with the U.S. and Australian military and multiple installations at one of Europe's most experienced metal advanced manufacturing parts manufacturers, making it the current standalone system for 3D parts production. The U.S. Army's Rock Island Arsenal also has a SPEE3D system.

Additionally, VRC Metal Systems and CenterLine (Windsor) Ltd. cold spray systems continue to offer in-situ repair capabilities. Impact Innovations, Rattenkirchen, Germany, continues to dominate the European market.

Recently, the VRC Raptor cold spray system (see cover page) was demonstrated at Ellsworth Air Force Base by the 28th Maintenance Group Additive Manufacturing Flight, where it conducted its first restoration of an active flying aircraft in May by repairing an over wing faring slip joint using high-pressure cold spray.

During his keynote address titled "Garbage in Equals Garbage out," Champagne presented a technical discussion on one of the most important advancements in cold spray: feedstock powders. He stated that specialized, engineered cold spray powders enable the production of bulk material that rivals its wrought counterpart in the as-sprayed condition.

Cold Spray Feedstock Powders

The cold spray processes generally incorporate feedstock powders produced from pure metals and/or metal alloys for the application of structural repairs and manufacturing components.

However, it is important to realize that one of the attributes of the cold spray process is the ability to create materials, through the use of powders, that would not be possible by conventional thermal spray techniques due to the maximum equilibrium solubility limits of elements and, therefore, unique multiphase powders are possible by cold spray.

There are commercially available, multicomponent powders made up of combinations of metals, metals and carbides, or other variations that result in two or more distinct material components to the powder — Fig. 3. These can be simple blends of powders or may be more advanced methods of combining different materials into each powder particle (i.e., granulation, milling, or encapsulation). Wear coatings may be applied by the cold spray process and often comprise two-phase powder mixtures of wear-resistant hard-phase particles and metal matrix soft-phase particles (e.g., CrC-Ni and WC-Co).

Fig. 2 — Achievement awards were presented to Julio Villafuerte (A) and Danielle Cote (B).

In the cold spray process, as its name suggests, the feedstock powder particles generally remain relatively cool and below their melting temperature, which provides a unique advantage over other powder processing additive manufacturing techniques. Many powder consolidation technologies (e.g., laser powder deposition, plasma spray, and high-velocity oxygen fuel spraying) are based on the complete melting of particles. During melting, the thermal history and microstructure of the feedstock powders are negated. Cold spray, however, carries a majority of the original feedstock microstructural characteristics into the resultant consolidated material — Fig. 4.

The powder characteristics affect the cold spray application process and material properties of the resultant deposit, and the old computer adage, "garbage in, garbage out," holds true in cold spray.

Birt stated, "If feedstock powders are not designed and controlled, then the cold spray process cannot be expected to reliably produce coatings and/or bulk materials that have predictable characteristics and material properties," such as the partial list shown in Table 1.

Additionally, Solvus Global (SG), Worcester, Mass., has helped to accelerate the advancement of structural cold spray repairs and 3D-printed parts through a concept that they commercialized as "Powders on Demand," which enables the cold spray community to take advantage of advanced powder development to produce the highest quality cold spray coatings and parts in the industry today. Special techniques to produce, characterize,

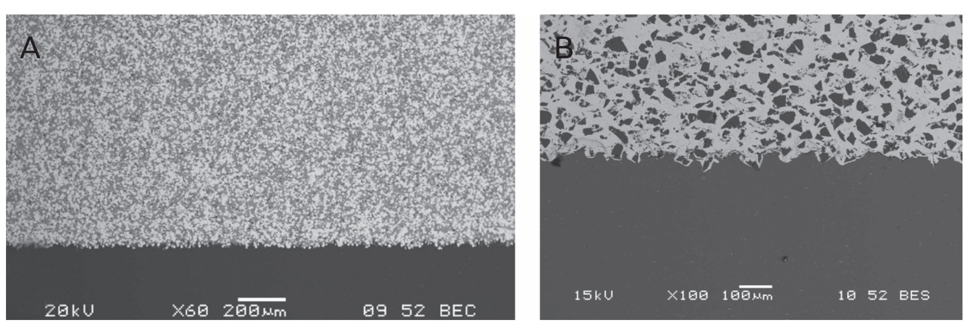

Fig. 3 — A — Cold spray coating using encapsulated tungsten with copper (80W-20Cu); B — cold spray coating of 49Cu51SiC. (Courtesy of the U.S. Army Research Laboratory, Aberdeen, Md.)

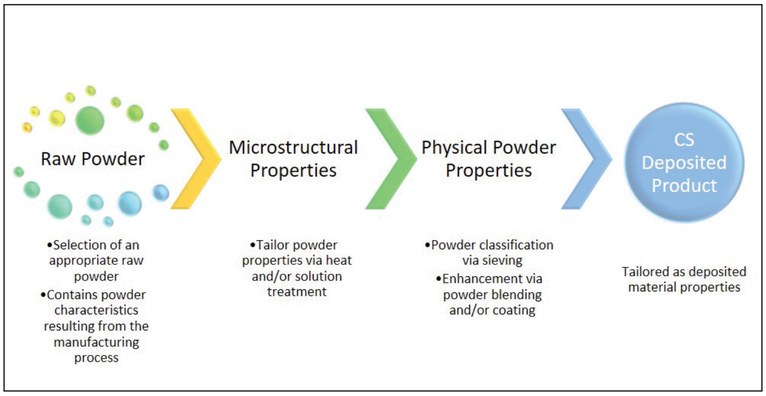

Fig. 4 — Schematic illustrating how powder properties can be engineered to attain specific characteristics and bulk material properties.

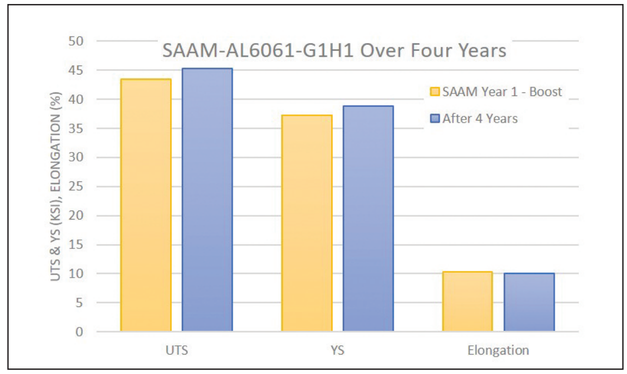

Fig. 6 — Results of tensile testing actual blocks of cold spray material produced using SAAM-AL6061-G1H1 feedstock powder, after four years of storage.

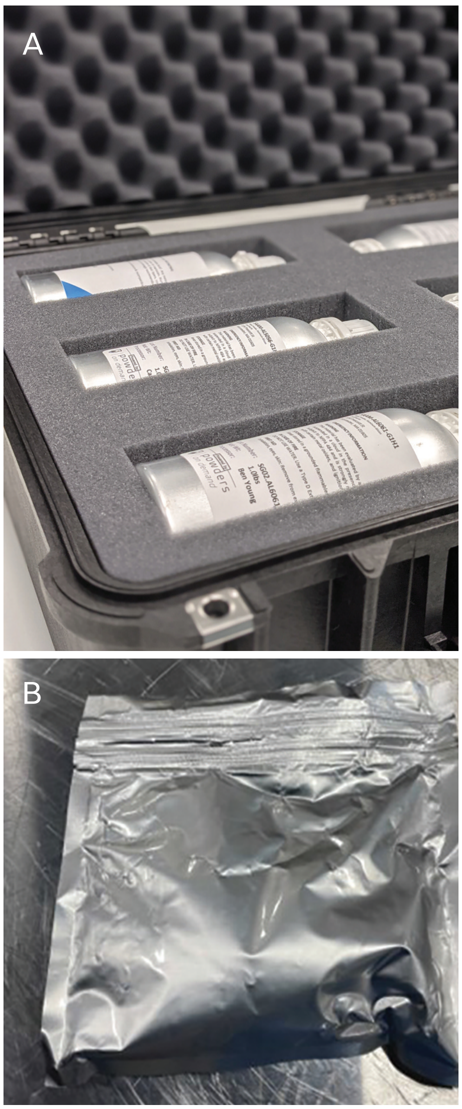

Fig. 5 — A — SAAM-AL6061-G1H1 feedstock powder in inertly packaged bottles suitable for point-of-need usage; B — example of the SAAM-AL6061-G1H1 feedstock powder packaged under an oxygen- and moisture-free, inert atmosphere in a mylar bag.

package, and store powders have consistently allowed unprecedented combinations of strength, hardness, and ductility.

Champagne spoke about the significance of feedstock powders by presenting test data from a study of 6061 aluminum powder produced by SG: SAAM-AL6061-G1H1 — Fig. 5A. The objective of the study was to demonstrate the ability of SAAM-AL6061-G1H1 to maintain its quality after being in storage for more than four years by spraying blocks of material large enough to be machine tensile bars and to subsequently characterize them, including the measurement of ultimate tensile and yield strength, along with elongation.

This powder was thermally processed, packaged, and shipped under an oxygen- and moisture-free, inert atmosphere in mylar bags ranging from 1 to 10 lb each — Fig. 5B. Multiple bags were originally produced and packaged in 2017.

The tensile results are shown in Fig. 6 and are consistent with the newly processed powder. It is important to note that most off-the-shelf gas atomized aluminum powders that are cold sprayed have elongation values below 1%. Additionally, it is a well-known fact aluminum powders hydrolyze when exposed to atmospheric conditions because of moisture in the air (even as low as 50% humidity, which is a laboratory condition). When aluminum powders hydrolyze, they form hydroxides on the exterior surface, which inhibit particle-to-particle adhesion and adversely affect mechanical properties, especially ductility. This is the importance of proper postprocessing, packaging, and storage of cold spray powders. Each production of aluminum powders processed at SG undergoes extensive characterization to ensure quality with a minimum shelf life of three years. This becomes very important when powders are being used at the point of need in adverse environments, such as in humid regions (on marine vessels, jungles, coastline areas, etc.).

EWI Cold Spray Center of Excellence

Another highlight of the CSAT was the revelation that Edison Welding Institute (EWI) will be creating a cold spray center in Buffalo, N.Y. Enthusiasm resonated throughout the audience by this announcement.

Table 1 — Cold Spray Process Variables and Material Properties Affected by Feedstock Powder

- Particle impact velocity and temperature
- Deposition efficiency
- Porosity
- Hardness
- Bond strength
- Ductility
- Fatigue behavior
- Corrosion performance
- Microstructure
- Surface finish (roughness/waviness)

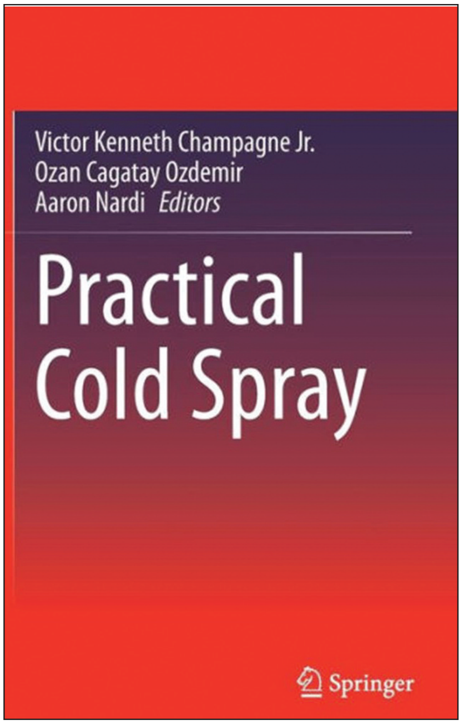

Fig. 7 — Book cover of Practical Cold Spray, *published in June 2021.*

EWI is a nonprofit organization that excels through its network of lab facilities, regional extension offices, manufacturing consortia, partners in commercialization, and joint collaborations to advance manufacturing competitiveness. There is a need for a depository of reliable and trusted data, and EWI can fill that void by serving as an unbiased entity for the cold spray community.

Practical Cold Spray

It was also reported at CSAT that a new cold spray publication was released in June 2021 — Fig. 7. This book is intended to provide a much-needed explanation of cold spray technology from a practical perspective and is derived from more than 20 years of research, development, and transition experience across the Department of Defense and various industrial sectors. It is well rooted in theory but is substantiated by empirical data and practical knowledge that provide potential users with the information necessary to recognize the advantages, as well as the limitations, of cold spray. Champagne, the main editor, instituted a holistic approach in the research and development of cold spray from the beginning and has investigated all aspects of the process, including feedstock powder, hardware and software, controls and automation, inspection and quality assurance, process and impact modeling and simulation, advanced materials characterization, machine learning and advancements in 3D additive manufacturing, and other relevant areas to fully develop, advance, and transition the technology. He called upon fellow colleagues Ozan Ozdemir and Aaron Nardi to serve as co-editors.

Conclusion

The CSAT conference continues to provide the means by which people can network and form research and business collaborations as well as advance research and development projects. The conference also serves as a forum for the introduction of advanced technology, novel cold spray powders, hardware and software, supporting technologies and processes, and specifications and standards that are essential toward the acceleration and transition of cold spray technology across the global market. CSAT has established a website for data sharing and a knowledge center at *coldsprayteam.com/csat-2021*.

Reference

1. U.S. Army Public Affairs. 2019. Secretary of the Army approves new advanced manufacturing policy. Retrieved from *army.mil/article/228151/secretary_of_the_army_approves_new_advanced_manufacturing_policy.*

Victor K. Champagne Jr. (victcham@aol.com) *is executive director of Cold Spray Action Team, Worcester, Mass. He is also CEO of Cold Spray Innovations International, Dudley, Mass., and a Fellow of ASM International. Aaron Birt* (aaron.birt@solvus-global.com) *is cofounder and CEO of Solvus Global, Worcester, Mass.*

By Tanaji Paul, Cheng Zhang, and Arvind Agarwal

Florida International University Performs Cold Spray Multiscale Mechanical Testing from Bulk Coating to Single Splat

The multiscale mechanical testing suite at Florida International University's new Cold Spray and Rapid Advanced Deposition (ColRAD) laboratory is advancing the design and characterization of high-strength coatings. ColRAD is the first cold spray facility among Florida universities that boasts a range of instruments that can evaluate the mechanical performance of coatings across length scales from centimeters to nanometers — a range of seven orders of magnitude. Before diving into mechanical testing, let's take a sneak peek into the laboratory and how it is advancing cold spray technology.

New Decade and Technology

The cold spray process emerged relatively recently in the 1990s and took off in the 21st century (Ref. 1). Cold spray technology sprays a shower of micron-sized solid powder particles to form a thick and robust coating. These particles usually consist of metals such as aluminum, steel, and tantalum, although ceramic particles can also be codeposited. The micron-sized powder is fed through a channel called a de Laval nozzle that is specially designed to direct energy and speed. Using this nozzle, powder particles can be accelerated to speeds twice that of sound. Traveling at these high speeds, the particles are stopped suddenly by the substrate on which they land. A coating is thus formed, built up of heavily deformed building blocks known as splats. The strength of these coatings can be attributed to these deformed splats mechanically interlocking with one another.

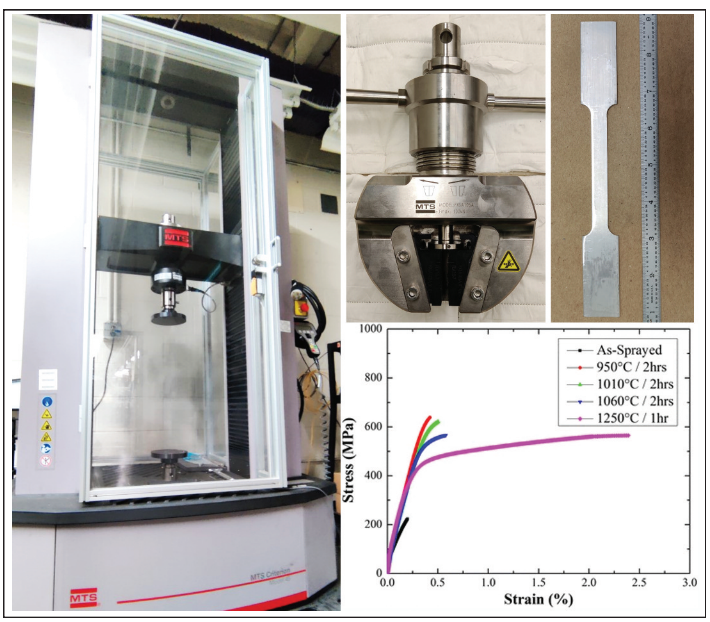

Fig. 1 — A universal mechanical testing instrument is used to conduct compression, tension, and fatigue tests using specially designed jaws on large-sized specimens. These tests reveal a wealth of information, such as the strength of the sample and the load it can accommodate before failure. These are useful to determine the operating conditions of cold-sprayed coatings (Ref. 2).

Cold Spray's Uniqueness

Cold spray stands out from other thermal spray processes, such as plasma spray and high-velocity oxyfuel spray, because of the processing temperature employed during spraying. For example, temperatures used during cold spray are generally around 300°–600°C, which are considerably low compared with plasma spray (10,000°C). So, in this regard, 300°–600°C is quite "cold." The advantage of keeping things this cold lies in preserving the properties of the raw materials used in spraying without oxidation and phase transformation.

Beyond State of the Art

By definition, cold spray appears to be just that — a spraying technology for developing protective metallic coatings. This is where ColRAD is striving to break through this barrier and redefine the cold spray landscape going beyond just metals and coatings. The lab is pushing the boundaries of ceramic coatings that are difficult to cold spray due to their high hardness and low deformability. ColRAD's focus is on cold spray research and education in additive manufacturing; repair and manufacturing at the point of need using a portable cold spray system; developing novel powder compositions including composite powders; developing novel electronic and biomedical applications; process control, diagnostics, and modeling; and multiscale mechanical properties evaluation.

Multiscale Mechanical Testing at ColRAD

Imagine trying to spot the Statue of Liberty in Google Maps. You would first view the United States, then zoom into New York, and then further magnify to the harbor area. Cold spray coatings are very similar, built of their unit cell "splat" in 3D, generating a hierarchical structure. The mechanical, thermal, and electrical properties of the cold-spray deposit depend on the splat geometry, intersplat region and boundaries, and collective response when subjected to bulk loading. Thus, mechanical testing of cold-sprayed deposits can first be done on a large sample a few centimeters long. Further details can be probed by measuring at the micrometer level. Finally, localized properties can be measured at a few nanometers.

One of ColRAD's missions is to probe into the mechanical response of a range of cold-sprayed coatings and materials at a systematically progressing length scale. ColRAD researchers are designing coatings that will show both attributes of strength and ductility. There is a trade-off between the two, and both cannot be maximized at the same time. Hence, careful tailoring of the properties must be done. A comprehensive suite of mechanical testing capabilities at the laboratory enables ColRAD researchers to probe the mechanical behavior of cold spray at multiple length scales, beginning from large scales of a few centimeters to extremely small nanometers. These capabilities thus span seven orders of magnitude in length scale.

Tension/Compression at Macroscale

ColRAD is equipped with a state-of-the-art universal mechanical testing machine that can gauge the strength of coatings at tens of centimeters in length scale — Fig. 1. A universal tester is designed to pull or compress a coating with the help of solid jaws that secure the sample in place. The load at which the coating can be deformed is determined ahead of the experiment. Additionally, there is flexibility to choose whether the test will happen rapidly or very slowly. As the test progresses, the instrument continuously generates a flow curve measuring the force required to stretch the coating to a specific extension. These can be used to demarcate the coating's characteristic properties, such as its yield strength and point of failure. A real-time video capture allows macroscopic strain analysis of the coating.

Fatigue and Bending at Macro/Mesoscale

Advancing one step further, the elastic mechanical properties of cold-sprayed coatings over a few centimeters of length scale can be probed by an instrument known as a dynamic mechanical analyzer (DMA). Cold-sprayed coatings are often employed in applications such as beams, which routinely undergo flexural or bending deflection. In such cases, elastic mechanical properties, where the material does not have any permanent deformation, become essential. DMA bending tests are done in a unique fashion where the free-standing coating rests on two knife-like edges like a beam. This beam is pressed by a loaded pin, which pushes down on the coating — Fig. 2. Using this three-point contact method, the coating is made to bend and straighten repeatedly. As a sinusoidally varying force, called a dynamic force, is applied, the instrument continuously measures the coating elastic modulus. DMA is also flexible in measuring energy lost during the vibration of individual splats in the coating. This loss can be tracked as the coating is gradually heated from cryogenic (–170°C) to high temperatures up to 600°C. Hence, DMA is an excellent technique to gauge the elastic properties of cold-sprayed coatings for applications in harsh environments both at low and elevated temperatures.

Mechanical Testing of Miniature Samples

A miniature load frame with a high load (4000 N) allows the transition from the macroscopic to microscopic regime of mechanical behavior — Fig. 3. Large-sized specimens needed for macroscopic tension and compression testing cannot always be reliably machined from cold-sprayed coatings due to the hard and brittle nature of the material or limited availability of the samples. At the same time, too-small microscopic testing does not provide all the information of interest. The miniature test frame shown in Fig. 3 fills this testing gap between macro- and microscopic testing while still generating the high loads necessary to deform cold-sprayed coatings. This instrument is equipped with a range of specialized, custom-developed fixtures, making it flexible. It can thus operate in several settings, such as indentation, tension, compression, four-point bending, and so on. The high load tester can also house a heating chamber aboard its mechanical platform to test coatings at elevated temperatures up to 400°C. The small design of the tester and heating chambers makes it very easy to secure it under a visualization device such as an optical or scanning electron microscope (SEM).

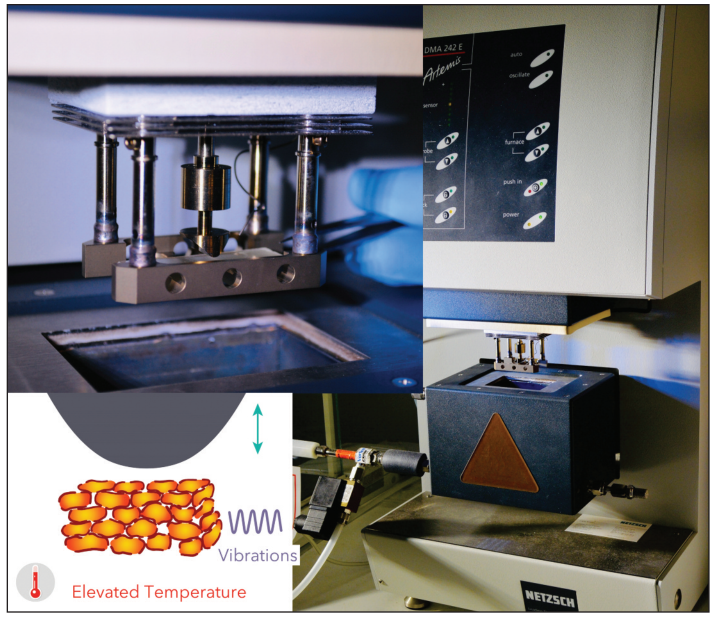

Fig. 2 — A DMA can provide insights into cold-sprayed material's elastic, damping, and cyclic deformation behavior. This instrument can be operated in various modes, such as bending, cantilever, compression, penetration, shearing, and tension. Cold-sprayed coatings can be tested from a cryogenic –170°C to an elevated 600°C (Ref. 3).

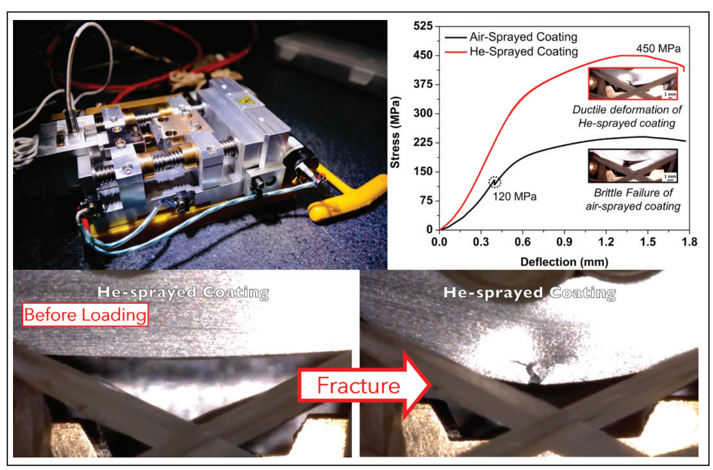

Fig. 3 — The high-load miniature load frame in the ColRAD laboratory can apply forces up to 4000 N. Responses of materials can be probed under a range of setups, including indentation, tension, compression, and four-point bending. It is also equipped with a heating stage capable of reaching 400°C (Ref. 4).

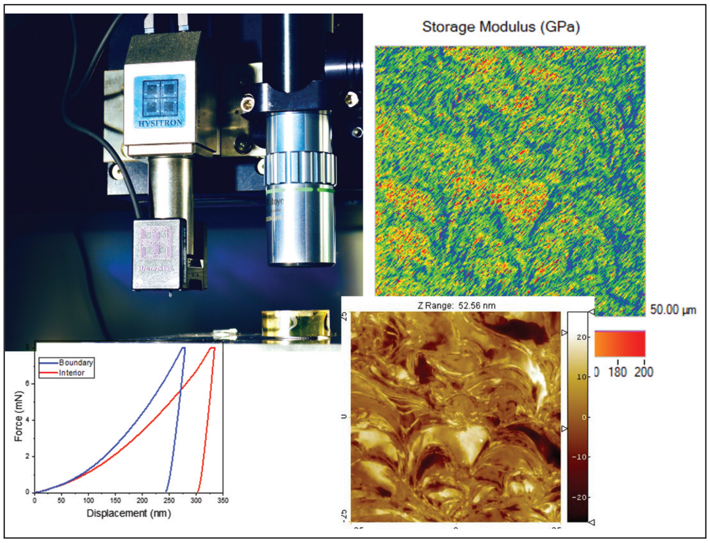

Fig. 4 — Exact locations with nanometer resolution can be probed for mechanical properties with the nanoindenter. Elastic modulus, hardness, scratch resistance, damping, and more can be obtained at the interior of cold-sprayed splats and jetting boundaries due to its superior force resolution of 1 nN and displacement resolution of 0.002 nm.

Thus, this instrument is a highly specialized device capable of revealing mesoscopic mechanical behavior of cold-sprayed materials under high-temperature environments and simultaneously visualizing the phenomenon.

Mechanical Testing at Micro/Nanoscale: Sharper Than a Needle

Cold-sprayed coatings are often characterized by heterogeneity in their structures due to differences in splat morphology. Specific locations within those materials undergo heavy deformation during high-speed impact. Due to deformations, these regions have hardened relative to the rest of the coating. Thus it is necessary to know the mechanical properties, particularly in these regions of interest. Nanoindentation exhibits a much higher resolution to probe local mechanized properties. A sharp diamond tip called a Berkovich indenter is forced into a specific area with high precision and indents with very small forces up to a few millinewtons — Fig. 4. The variation of the force as a function of the depth of indentation can be utilized to calculate fundamental coating properties, such as elastic modulus and hardness of the coatings. The nanoindenter is also capable of mapping the elastic modulus of the coating as a distribution over the coating structure with extremely high resolution (Ref. 5). For example, an area of 4 μm^2 can be divided into a square array of a whopping 256 × 256 = 65,536 pixels. This means the variation in elastic modulus between two adjacent points separated by a distance of 8 nm can be reliably measured.

Seeing Is Believing: In-Situ Mechanics

ColRAD is making this reality by visualizing material deformation phenomena in real time as they happen with a technique known as in-situ nanoindentation. With this method, the entire indentation and scratching process (Fig. 5) is conducted by a miniaturized nanoindenter placed inside the SEM chamber. Indentation by the tip and capturing of video by the microscope coincide (Ref. 6). This is more advantageous since ex-situ characterization can only provide information before and after the experiment but not during. Hence, in-situ nanomechanical testing can reveal insights not otherwise discoverable by conventional characterization techniques. This allows studying adhesion between splat and interface and between two splats.

Simulation and Modeling

These experimental techniques are also integrated with computational modeling, as presented in Fig. 6. Experimental techniques are not always sufficient to draw a comprehensive picture. For example, ColRAD researchers integrate experimental localized nanoindentation properties to simulation software to evaluate bulk elastic properties using a finite element modeling software called OOF2. The uniqueness of this technique lies in that experimental values are fundamental material properties. Usually, these computations are conducted with values taken from a standard materials handbook. However, those values are not representative of cold-sprayed microstructures having very different properties. Research at ColRAD incorporates both the role of characteristic cold-sprayed microstructure and experimental true material properties. Data hidden inside pixels of im-

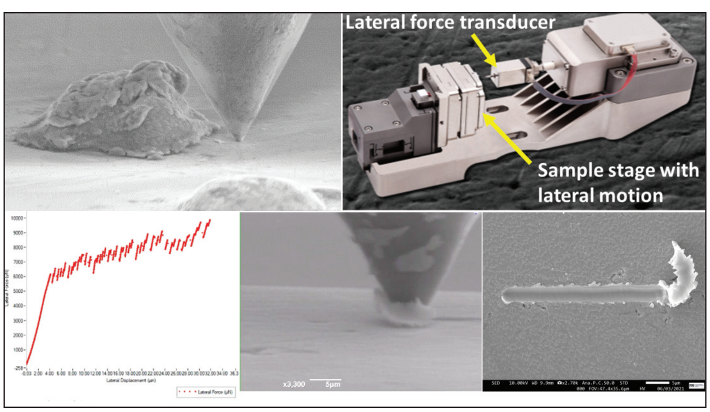

Fig. 5 — An In-situ picoindenter can probe into mechanical properties inside an electron microscope, generating real-time force data simultaneous to imaging. ColRAD researchers can obtain a wealth of information about the deformation mechanics of materials as they happen.

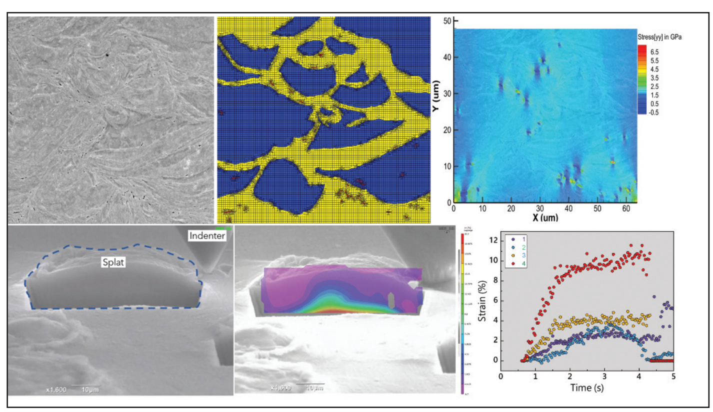

Fig. 6 — Multiscale modeling using microstructural finite element analysis and digital image correlation techniques. Using software such as OOF2 and ViC2D, data from pixels in images and videos can be translated to mechanical response characteristics such as stress, strain, and elastic modulus.

ages and videos take a new form into stress and strain. Using a technique known as digital image correlation, the movement of individual pixels during the deformation of coatings can be analyzed to understand their mechanical strength characteristics. This is conducted using the software ViC2D, which can explore hundreds of images and provide high-resolution deformation data.

Conclusion

ColRAD is continuing its mission of advancing cold spray technology through research and development. It is also using its expertise to establish training and certification programs on coating technology. This will enable creating a strong foundation for the next-generation science, technology, engineering, and mathematics workforce.

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ITSA and AWS C2 Committee on Thermal Spray to Meet in Chicago

Pictured is ITSA's last in-person meeting, which took place in 2019 during the 3rd Annual Advanced Coatings Symposium (Aerospace) and Annual Membership Meeting.

The American Welding Society (AWS) C2 Committee on Thermal Spraying will hold its Meeting on Thermal Spray Standards in Chicago, Ill., on September 14 at 9:00 a.m. CT. Members will convene in the Lake Michigan room at Hilton Chicago & Towers. The schedule includes presentations from the terms and definitions as well as cold spray task groups, C2A Subcommittee on Machine Element Repair, C2D Subcommittee on Thermal Spraying, C2F Subcommittee on Thermal Spray Operator Qualification, and more.

In addition, the International Thermal Spray Association (ITSA) will gather for its annual membership meeting on September 15 at 1:00 p.m. CT inside Chicago's McCormick Place (Room N231) during FABTECH. This will mark the first in-person meeting for ITSA since the 2019 3rd Annual Advanced Coatings Symposium (Aerospace) and Annual Membership Meeting. There will be an opportunity to socialize with fellow members of the industry following the ITSA meeting. To register for the event, visit *awo.aws.org/conferences/upcoming-conferences/itsa-annual-membership-meeting-2021*.

Wall Colmonoy and Strain Harden Celebrate One-Year Partnership

Wall Colmonoy and Strain Harden announced the one-year anniversary of their Middle East strategic partnership for the countries of United Arab Emirates and Saudi Arabia.

On June 7, 2020, Wall Colmonoy reached a distributor partnership agreement with supplier Strain Harden to sell Colmonoy® Surfacing Alloys, Nicrobraz® Brazing Alloys, ColWear Wear Plates, and castings to the United Arab Emirates and Saudi Arabia. The agreement strengthens Wall Colmonoy's presence and market coverage in the Middle East.

Strain Harden is an in-Kingdom supplier and provides local and commercial support as well as stocks product for quick delivery.

"Customers are glad to hear that Wall Colmonoy now has a local presence. They are eager to use a product they know and trust and have used in other parts of the world," said Majd A. Hosn, managing partner, Strain Harden.

United Arab Emirates and Saudi Arabia accounts will be managed by Strain Harden directly, with full technical and commercial support by Wall Colmonoy for new and existing customers.

Oerlikon Balzers Collaborates with MTU to Coat Aero Engine Components

The contract between Oerlikon Balzers and MTU Aero Engines will further improve the efficiency of the PW1100G-JM aero engines by providing erosion-resistant coatings for MTU's high-pressure compressor aerofoils. (Photo courtesy of MTU Aero Engine.)

Oerlikon Balzers, Balzers, Liechtenstein, a surface supplier brand of the Oerlikon Group, has signed a ten-year contract with MTU Aero Engines, a German aero engine manufacturer. The agreement allows the surface company to apply MTU's own erosion-resistant coating, ERCoatnt, on aerofoil components of next-generation GTF™ aero engines used in the Airbus A320neo aircraft. The coating will further improve the efficiency of this engine. MTU Aero Engines is also partnering with Pratt & Whitney on this engine.

With this long-term agreement, Oerlikon Balzers takes another step forward in supplying advanced surface technologies and coatings for the aerospace industry. MTU will profit from the industrialization and expertise of a leading supplier of thin-film physical vapor deposition (PVD) and its equipment portfolio by enabling the delivery of consistent and repeatable product quality in a short period of time.

The long-term partnership between the two companies will leverage their respective competencies and further contribute to improving the efficiency of the PW1100G-JM aero engines by providing erosion-resistant coatings for MTU's high-pressure

— *continued on page 19*

Remote Monitoring Service Ensures Filter Life and Reduces Operating Costs

The iCue™ remote filtration service monitors industrial dust collectors in real time to help facility teams improve dust collection maintenance and management. The service allows customers to improve compliance tracking and validation with its new particulate monitoring sensor. Helping environmental, health, and safety teams meet compliance, this sensor continuously detects the amount of particulate material in the outlet stack of plant dust collectors, sending alarms if particulate levels rise above defined pa-

rameters. Maintenance teams can then quickly inspect if filters are damaged or installed improperly and resolve other equipment issues leading to increased or potentially unsafe particulate levels. Additionally, the service tracks the filter cleaning system in pulse-jet dust collectors and detects if one or more of the pulse-jets valves are malfunctioning. Tracking and managing these proactively allows the maintenance team to save time, increase filter life, and reduce compressed air and electricity waste. Recent updates also make it possible to easily share data with maintenance partners. A "Partner View" feature allows customers to grant the company's network of certified dealers and service centers, or other service providers, access to their service dashboard, giving third-party maintenance staff the ability to monitor real-time performance data and quickly respond to maintenance alerts. Finally, the monitoring service is applicable with dust collectors that operate using positive air pressure in addition to existing negative air pressure systems, further extending the applications where the service can be deployed across the factory. The compact gateway and wireless connection are simple to install, require no IT integration with an internal automation network, and are compatible with nearly all major dust collector brands. An annual subscription includes hardware, automated reports, real-time maintenance alerts, and a web-based dashboard with real-time and historical data.

Donaldson Co.
donaldson.com / (833) 310-0017

Website Makes It Easier to Stock a Fabrication Shop

American Torch Tip Co. upgraded website adds a sharp new look and feel and allows users to seamlessly navigate more than 20,000 products and cost-saving solution.

— continued on page 19


Gregory T. Wahl

Gregory T. Wahl of Johns Creek, Ga., passed away on May 14. He was 65. A native of Lexington, Ky., Wahl attended the University of Kentucky for his undergraduate degree and the University of Pittsburgh for his post-graduate degree. After graduating with a master's degree in business administration, he worked at Union Carbide Coatings Service from 1979 to 1992. He then joined Praxair Surface Technologies until 2007. The same year, he went on to H. C. Starck North American Trading LLC as a regional sales manager. He stayed on with North American Höganäs after their acquisition of the Surface Coating Technologies division of H. C. Starck, where he remained until his passing. Wahl loved Kentucky basketball, Indy car racing, and horse races. He was incredibly proud and supportive of his wife's and children's musical pursuits and enjoyed attending their concerts. Most of all, he loved reading the Word of God and sharing his Christian faith. Wahl is survived by his wife, Ellen Wahl; son, Mark (Rebecca); daughter, Catherine; brothers, David and Danny; sister, Karen; as well as a niece, nephews, numerous cousins, and cherished friends.


S. C. Modi

S. C. Modi, managing director of Metallizing Equipment Co., India, passed away on May 28. He was 71. Born in Jodhpur, India, he graduated from the University of Jodhpur in 1971 with a mechanical engineering degree. In 1972, he joined his family business along with his older brother M. D. Modi. He developed surface engineering technology in the areas of thermal spraying, shot peening, and abrasive blasting. He was a member of the American Society of Materials. Over the years, Modi contributed several technical papers that were published in national and international magazines. He was a main sponsor of the Asian Thermal Spray Conference held in Hyderabad, India, in 2014. He promoted a world-class thermal spray laboratory accredited to ISO 172025:2017. He attended almost all international thermal spray conferences held in the past 40 years and developed close relations with the thermal spray community worldwide. Modi was considered by some as the "father of the thermal spray industry in India" and served as a mentor to many within the industry worldwide. He is survived by his wife, Vandana; daughter, Anubha; and son, Ankur.

Guidelines for submitting a *SPRAYTIME®* feature article

Have you though about writing a feature article for consideration in SPRAYTIME?

If so, our staff stays on the lookout for original, noncommercial, practical, and hands-on stories. Potential ideas to focus on include a case study, recent company project, tips for handling a particular process, and so on.

Here's an easy breakdown of our guidelines:

- The text of the article should be about 1500 to 2000 words and provided in a Word document.
- Line drawings, graphs, and photos should be sent in high-resolution of 300 or more dots per inch.
- Plan on one figure for every 500 words, and provide captions for every image. Also, if a nice lead photo is available, please include it for review.
- The authors' names, along with the companies they work for and their positions, should be listed.

If you'd like to dicuss a particular idea or email a submission for evaluation, please contact Editor Cindy Weihl at *cweihl@thermalspray.org*.

ITSA Member News

In the last issue of *SPRAYTIME*®, I mentioned that the International Thermal Spray Association (ITSA) would be having a virtual annual meeting again this year, but the executive board has since had a change of heart. As the country opened up and many restrictions lifted, I am happy to inform our membership that we will have an in-person meeting at FABTECH in Chicago, Ill., this September. We had originally thought it would be prudent to have another virtual meeting, but after getting feedback from members, we decided that FABTECH would be a good meeting venue considering that the American Welding Society C2 Committee on Thermal Spray will be meeting there as well. The Annual ITSA Membership Meeting will take place on Wednesday, September 15, from 1:00 to 3:00 p.m. in room N231 of the McCormick Place Convention Center. We will also have a networking/social get-together directly after the meeting. I am really looking forward to seeing as many of you as possible! As things evolve and restrictions are lifted, I hope everyone continues to stay safe as we resume conducting business in the way we used to prior to the COVID-19 pandemic. Things may not go back to being exactly the same (as there are definitely new ways of conducting business), but I think we are close to being out of the woods.

Ana Duminie
Chair

ITSA MISSION STATEMENT

The International Thermal Spray Association (ITSA), a standing committee of the American Welding Society, is a professional industrial organization dedicated to expanding the use of thermal spray technologies for the benefit of industry and society. ITSA invites all interested companies to talk with our officers and company representatives to better understand member benefits.

OFFICERS

Chair: Ana Duminie, *North American Höganäs*
Vice-Chair: Mollie Blasingame*, Superior Shot Peening & Coatings*

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(above officers plus the following)
Jim Ryan, *TechMet Alloys*
David A. Lee, *David Lee Consulting LLC*
Bill Mosier, *Polymet Corp.*
Peter Ruggiero, *Curtiss-Wright Surface Technologies*

ITSA SCHOLARSHIP OPPORTUNITIES

ITSA offers annual graduate scholarships. Since 1992, the ITSA scholarship program has contributed to the growth of the thermal spray community, especially in the development of new technologists and engineers. ITSA is very proud of this education partnership and encourages all eligible participants to apply. Please visit *thermalspray.org* for criteria information and a printable application form.

ITSA THERMAL SPRAY HISTORICAL COLLECTION

In April 2000, ITSA announced the establishment of a Thermal Spray Historical Collection that is now on display at the State University of New York at Stony Brook in the Thermal Spray Research Center.

Growing in size and value, there are now more than 30 different spray guns and miscellaneous equipment, a variety of spray gun manuals, hundreds of photographs, and several historic thermal spray publications and reference books.

Future plans include a virtual tour of the collection on the ITSA website for the entire global community to visit. This is a world-wide industry collection, and we welcome donations from the entire thermal spray community.

ITSA *SPRAYTIME*

Since 1992, ITSA has been publishing *SPRAYTIME* for the thermal spray industry. The mission is to be the flagship thermal spray industry publication providing company, event, personnel, product, research, and membership news of interest to the thermal spray community.

JOIN ITSA

ITSA Membership is open to companies involved in all facets of the industry — equipment and materials suppliers, job shops, in-house facilities, educational institutions, industry consultants, and others.

Engage with dozens of like-minded industry professionals at the Annual ITSA Membership Meeting, where there's ample time for business and personal discussions. Learn about industry advancements through the one-day technical program, participate in the half-day business meeting, and enjoy your peers in a relaxed atmosphere complete with fun social events.

Build awareness of your company and its products and services through valuable promotional opportunities — a listing in *SPRAYTIME*, exposure on the ITSA website, and recognition at industry trade shows.

Plus, ITSA Membership comes with an American Welding Society (AWS) Supporting Company Membership and up to five AWS Individual Memberships to give to your best employees, colleagues, or customers. Visit *aws.org/membership/supportingcompany* for a complete listing of additional AWS benefits.

For more information, contact Adrian Bustillo at (800) 443-9353, ext. 295, or *itsa@thermalspray.org*. For an ITSA Membership application, visit the membership section at *thermalspray.org*.

ITSA Mission Statement

The International Thermal Spray Association, a Standing Committee of the American Welding Society, is a professional industrial organization dedicated to expanding the use of thermal spray technologies for the benefit of industry and society.

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Industry News

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compressor aerofoils. The Oerlikon Balzers INNOVENTA giga with arc evaporation technology will ensure high-quality coatings of MTU's components. It is the largest of the high-tech INNOVENTA coating systems and is an ideal platform for coating large components, allowing accommodation of workpieces higher than 1.7 m with a substrate diameter of up to 0.7 m and a loading capacity of up to 3000 kg.

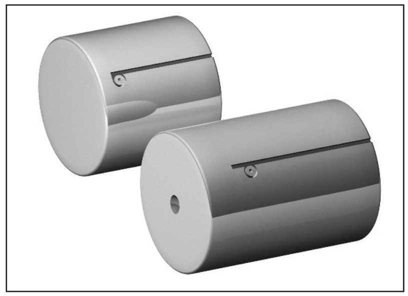
Mahr Advances Its Air Gaging Capabilities

Mahr Inc., Providence, R.I., a global manufacturer of precision measurement equipment used for dimensional metrology, has invested in manufacturing technology, process and product improvements to enhance performance for air gage tooling and masters.

The company has bought new manufacturing machines and employed a proprietary process in intelligent part programming to produce standard air plugs and their configurations more efficiently. The result will be shorter lead time and faster deliveries to customers.

"Mahr is starting to date orders for air plugs going through its new standard configuration process with an uncertified master for two-week delivery or three weeks with a certified master," said George Schuetz, director of precision gages at Mahr. "Similar delivery improvements will also be seen for larger quantities of these standard configuration air plugs."

Air tooling is designed for use on the shop floor in some of the harshest manufacturing environments, often measuring countless numbers of inside and outside diameters and lengths over the life of the part manufacturing cycle. Air gaging is also used for measuring pump barrel rods or in automatic gaging operations where millions of cycles are common.



Mahr has made significant investments to improve deliveries and performance of its air gage product line.

The company is now coating its air tools with a new physical vapor deposition AlCrN-based coating that offers superior wear characteristics, which is ideal for improving the life performance of air tooling in production environments. The new coating replaces environmentally harmful chrome plating that was previously used for high-wear applications. It provides excellent hardness and shock resistance.

The coating is dark grey in color, distinguishing the new plug with its new appearance. Even in high humidity, it provides ideal wear- and rust-prevention results. This new coating process will continue to be implemented throughout the company's air tooling line of products in the future.

Product Spotlight

— continued from page 14

The website features testimonials, brochures, technical guides, cut charts, blog articles, and e-catalogs for gas metal arc and gas tungsten arc welding; plasma, oxyfuel, and laser cutting; and thermal spray. Users can request a catalog, view schematics, learn about product solutions, and browse the company's entire product offering and request a quote with the click of a button. A live chat feature is also available during business hours.

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