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SPRAYTIME

American Welding Society | International Thermal Spray Association

Masking for Thermal Spray

IN THIS ISSUE: INDUSTRY NEWS ■ PEOPLE IN THE NEWS ■ ITSA SCHOLARSHIP RECIPIENT

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On the cover: Combustion wire spraying of a metal-masked component. (Photo courtesy of Oerlikon Surface Solutions.)

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Mollie Blasingame
Chair

It's almost time to meet again! I am excited that the International Thermal Spray Association (ITSA) has finalized plans for the 2023 ITSA Annual Meeting on August 9 and 10 in Buffalo, N.Y. The meeting will be hosted by EWI and include a visit to Buffalo Manufacturing Works for a tour of the new Cold Spray Center of Excellence.

The Buffalo gathering will be ITSA's first official annual meeting since 2019, and if our meeting during FABTECH in November 2022 was any indication, everyone is eager to get together again for an all-out event.

I would like to personally invite all ITSA members to join us the morning of August 9 for the meeting. Later that day, ITSA members will have the opportunity to participate in EWI activities, which will include presentations and a tour of the cold spray facility (transportation will be provided). The AWS C2 Committee on Thermal Spraying is planning to meet on August 8, the day before the ITSA meeting and tour. The committee will continue to carry out its efforts to review, create, and revise standards on thermal spray according to the latest industry developments.

It's been too long since we've gathered as a fully organized body in one location. I cannot wait to see the results of this conference when we spend quality time sharing ideas, learning from each other, and working together to advance the thermal spray industry.

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.

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Kirk Fick, vice chair, Cincinnati Thermal Spray Inc.

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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. Visit *thermalspray.org* for criteria information and a printable application form.

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

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 ITSA Annual 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 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's Annual Meeting Scheduled for August 9–10

The annual meeting of the International Thermal Spray Association (ITSA) will be held August 9–10 in Buffalo, N.Y.

The event will include ITSA's first formal business meeting since November 2022 along with a visit to the Buffalo Manufacturing Works Cold Spray Center of Excellence and its new cold spray research center, operated by EWI. In addition to presentations by EWI's team, the agenda will also include a meeting of the AWS C2 Committee on Thermal Spraying and a group dinner.

Visit *thermalspray.org* to register and for more information about the event.

Apply for a $2000 ITSA Scholarship

Applications for the International Thermal Spray Association's (ITSA's) Scholarship Program will be accepted until July 16. Up to three one-year scholarships worth $2000 each may be awarded. Since 1991, the ITSA Scholarship Program has contributed to the growth of the thermal spray community, especially the development of new technologists and engineers. To be considered, applicants must meet all of the following criteria:

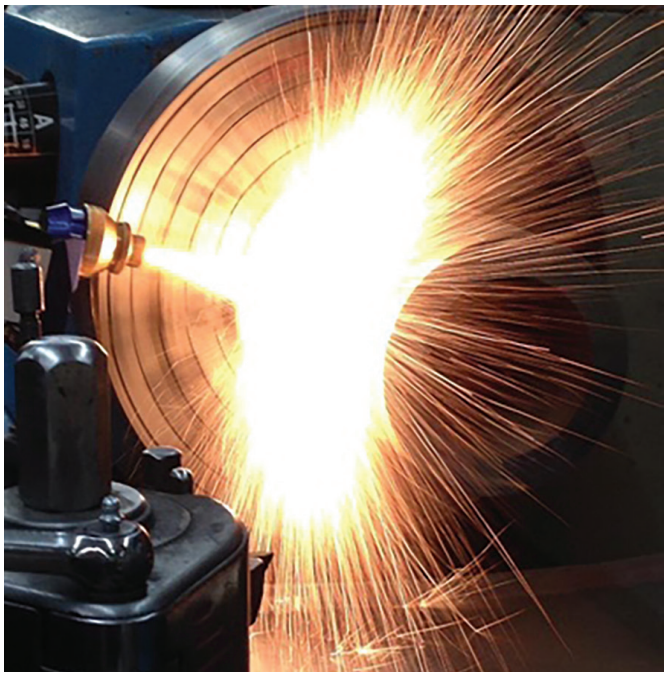
- Be actively pursuing a postgraduate degree in thermal spray processes (plasma, flame, arc, high velocity oxygen fuel) or materials at an accredited U.S. university;
- Have at least one year of studies remaining after this year;
- Be recommended by a supervisor/professor of the university they are attending (The student's financial need must be verified by a professor. The student must also be recommended by at least one industrial source); and
- Present an essay about their interest in pursuing a career in thermal spray (maximum of three typed pages).

The application can be accessed at *aws.org/foundation/page/itsa-graduate-scholarship-application*. Winners will be announced in August.

Distribution Deal Brings Farsoon 3D Printers to Canada

Farsoon America, the Austin, Tex.-based subsidiary of China-based plastic laser sintering and metal laser melting systems supplier Farsoon Technologies, has entered into a distribution deal with Canada-based Indurate Alloys Ltd., a supplier of thermal spray, laser, and plasma transferred arc powders. The deal will allow Indurate to sell Farsoon's additive manufacturing (AM) hardware to Canadian customers.

"Farsoon America is looking forward to building a strong relationship with Indurate Alloys's professional technical sales team," said Jim Braddick, sales director of Farsoon America. "We are dedicated to advancing AM in the Canadian region."



Through its new partnership with Indurate Alloys, Farsoon will sell its additive manufacturing hardware to Canadian customers.

Indurate Alloys was founded in 2011 to serve Western Canadian thermal spray and hardfacing customers. Its customer base is primarily composed of businesses in the oil and gas, petrochemical, and mining industries.

Höganäs Opens ArcX Facility in Houston

Höganäs, a manufacturer of metal powders, unveiled its new ArcX facility in Houston, Tex. From the 12,000-sq-ft building, which is located close to many large original equipment manufacturers (OEMs) in various industries, the company will provide customer support, application development, technical solutions, and training to its surface coating customers. It's the fifth ArcX facility opened by Höganäs worldwide.

"Our new ArcX facility in the United States is an important strategic move for Höganäs, particularly in North America with many OEMs as driving forces to develop technological breakthroughs," said Hans Keller, president of surface and joining technologies. "This expansion is part of our company's continued commitment to serving our customers in the Americas."

The Höganäs team will offer services for customer application development and process optimization for laser, plasma transferred arc welding, and thermal spray applications, including concept development, prototyping, process optimization, and taking products to the market.

IGS and Iberfluid Forge Distribution Partnership

IGS has partnered with Iberfluid Instruments for distribution in Spain and Portugal.

International Global Services (IGS), Richmond, Va., a provider of surface protection solutions, announced an exclusive long-term distribution partnership with Iberfluid Instruments, a Spain-based industrial instruments and services company. The deal will increase the availability of IGS services in Spain and Portugal.

Under the new partnership, Iberfluid, which has offices in Madrid, Barcelona, Bilbao, and Seville as well as Lisbon, will distribute the full portfolio of IGS solutions to the Spanish and Portuguese markets. These will include a high velocity thermal spray (HTVS) solution to stop corrosion and erosion; the Hot-tek™ portfolio of online maintenance solutions; and Cetek ceramic coatings and Tube Tech fouling removal solutions, both designed to improve heat transfer efficiency and reduce emissions in fired heaters.

"Spain and Portugal remain important markets for IGS in Europe," said Colin Bateman, IGS's director of business development for Europe, the Middle East, and Africa. "The partnership will allow IGS to increase its reach through Iberfluid's five hubs in the region whilst nurturing its strong relationships and technical capabilities across a range of industries and applications."

SBTi Approves Bodycote's Emissions Target

Bodycote, a provider of heat treatment and special thermal processing services located in Macclesfield, United Kingdom,

had its near-term science-based emissions target approved by the Science Based Targets initiative (SBTi).

SBTi is an independent global body that enables businesses to set and validate emissions reduction targets in line with the latest climate science and strict criteria. Targets are considered science-based if they are in line with what the latest climate science deems necessary to meet the goals of the Paris Agreement: limiting global warming to well-below 2°C (35.6°F) above preindustrial levels and pursuing efforts to limit warming to 1.5°C (34.7°F).

"Managing energy and reducing our environmental impact have long been part of our corporate culture," Bodycote Chief Executive Stephen Harris said. "Bodycote is focused on ethical and sustainable growth and proud of our commitment to setting an ambitious target. Bodycote encourages other businesses to commit to science-based targets."

With more than 165 facilities in 22 countries, Bodycote has committed to reducing its absolute scopes 1 and 2 greenhouse gas emissions by 28% by 2030 from a 2019 base. Scope 1 includes all emissions directly linked to and emitted by Bodycote facilities. Scope 2 includes all emissions linked to purchased inputs associated with the purchase of electricity, steam, or cooling.

SBTi is a collaboration between the Carbon Disclosure Project, United Nations Global Compact, World Resources Institute, and World Wide Fund for Nature.

Oerlikon AM Helps Students Launch Rocket at Spaceport America Cup

Oerlikon AM, an international provider of additive manufacturing (AM) technologies to high-tech industries, played an integral part in the Academic Space Initiative Switzerland's (ARIS's) launch of a supersonic sounding rocket at the 2022 Spaceport America Cup in New Mexico.

ARIS brings together students from Swiss universities who are interested in space exploration. Oerlikon AM supported ARIS's HELVETIA team with additive manufacturing expertise and production capabilities to develop and 3D-print various components for the rocket, including the injector and nozzle. The rocket, which is 5.3 m (17 ft) long, carries avionics and 4 kg (8.8 lb) of payloads to an altitude of 30,000 ft.

Through AM, parts of the rocket were produced for sustainability and cost efficiency. Using selective laser melting, the injector's weight was reduced by 1.2 kg (2.6 lb), and the complexity of its assembly was greatly reduced. The additively manufactured nozzle was made with MetcoAdd 718C (Alloy 718) to withstand the high temperatures and stresses of a launcher firing.

Using 3D printing technology, the HELVETIA team produced a nozzle that met the industry standard and reduced its weight by about 21 lb compared to a conventionally manufactured nozzle.

R. "Bob" W. Roth

AWS Welcomes Robert Roth as Interim Executive Director and CEO

Robert "Bob" W. Roth has been selected by the AWS Board of Directors as the interim executive director and CEO. The appointment comes as former Executive Director and CEO Gary Konarska II transitioned into his new role as vice president, president, Europe Welding, The Lincoln Electric Co. AWS thanks Konarska for his three years of service leading the organization.

Roth has been a volunteer at AWS for more than 20 years, serving on the company's Finance Committee, on its Board of Directors, and as AWS president in 2020 and 2021. He retired as president of RoMan Manufacturing in January 2023. Roth will ensure ongoing focus on the execution of AWS's 2023 organizational goals along with continuity and stability during the search for a successor.

Further, a search committee consisting of AWS Board leadership and a member of the AWS Foundation will work with an executive search firm to identify the next executive director and CEO. There will be periodic updates throughout the search process, and the Board is committed to finding the best candidate as quickly as possible.

Kennametal Appoints Michael Pici to Vice President of Investor Relations

Kennametal Inc., Pittsburgh, Pa., a supplier of tooling and industrial materials, has named Michael Pici as vice president of investor relations. He will be responsible for the company's global investor relations strategy and will report directly to Vice President and Chief Financial Officer Patrick Watson.

Pici has more than 30 years of experience across investor relations, financial analysis, reporting, and corporate development. He has held financial leadership positions at numerous publicly traded companies and has more than a decade of investor relations experience.

He holds a bachelor's degree in marketing management, an MBA in financial management from Pace University, and a Six Sigma Certification from the University of Michigan.

Pici replaces Kelly Boyer, who is moving into a new role at Kennametal. She and Pici will work together to ensure a seamless transition.

BY DAVE ROSENBAUM

ITSA Scholarship Recipient Focuses on THE FUTURE OF HVOF

When Donald McMahon received a bachelor's degree in engineering science from Stony Brook University, Stony Brook, N.Y., in 2022, he didn't see graduation as the end of a chapter in his life. He saw it as part of a story that was still in progress.

"I prefer not to leave work incomplete," McMahon said. "I found that I was sitting on a mountain of data that was shaping up nicely into a great story, and I wanted to be the one to tell it."

McMahon has continued to tell that story while pursuing a master's degree in material science and engineering at Stony Brook and as a research assistant in the school's Center for Thermal Spray Research, where his work involves studying plasma and high velocity oxyfuel (HVOF) spray coating processes. He said receiving a 2022 International Thermal Spray Association (ITSA) scholarship has allowed him to continue his research into the interplay between stoichiometry, standoff distance, and matrix content in HVOF without worrying about whether he would receive funding.

"One of the most interesting aspects of thermal spray is that despite the breadth of knowledge that the industry has gained over the last century, we are still discovering new fundamental theories that continue to drive the technology to its limits and beyond," he said. "Coupled with this great beyond that we find ourselves entering is the frustration that comes with balancing tried and true practices and specs with new and developing techniques that are discovered thanks to new knowledge of the interplays between physics and chemistry that is the cornerstone of thermal spray."

Since receiving the scholarship, McMahon has been studying the effects particle kinetic energy and matrix content have on stresses generated in HVOF cermet (a mixture of ceramics and metals) coatings.

"To do this, I have been using ReliaCoat Technologies's In-situ Coating Property Sensor to correlate evolving stress in the coatings with the velocity of particles sprayed at various standoff distances."

After he graduates, McMahon plans to work at Metallizing Service Co. in West Hartford, Conn.

"He follows in the footsteps of prior Stony Brook ITSA scholarship winners who have been important contributors to the U.S. and international thermal spray industry," said Jonathan Gutleber, technical leader of coating and materials development at Oerlikon Metco, Westbury, N.Y. McMahon conducted an experiment with the company last September.

Gutleber continued, "His work on HVOF, especially the role of process gas stoichiometries on carbide coating microstructure evolution and properties . . . is highly significant and important, especially with incorporation of diagnostic tools to make subtle distinctions between coating structures and performance."

McMahon is confident he is entering an evolving industry.

> **"I believe that the future of thermal spray looks bright."**

"My advice [to future students] would be to give thermal spray a chance, and, if you do, always try to think outside the box," he said. "There are still plenty of improvements to be made, and it takes someone with curiosity to find them."

McMahon was one of two recipients of the 2022 ITSA scholarship. The other was Tyler Kleinsasser, a student at South Dakota School of Mines and Technologies, Rapid City, S.Dak.

DAVE ROSENBAUM (*drmiamiice@aol.com*) is a contributor for *SPRAYTIME*.

NOW ACCEPTING SCHOLARSHIP APPLICATIONS

Since 1991, ITSA has provided scholarship assistance to technologists and engineers who are pursuing a postgraduate degree in either thermal spray processes (plasma, flame, arc, HVOF) or materials at an accredited United States university.

Up to three (3) scholarships
$2,000.00 each

Application Deadline: July 16th, 2023

For more eligibility information or to apply,
visit *thermalspray.org/scholarship*

BY STEVE BOMFORD

SUPERHERO or VILLAIN?

When getting ready to thermal spray, it is important to address the necessary evil that is masking. Masking is employed as a protection process required to prevent damage to the part being coated both from surface roughening prior to coating and from the deposition process itself. Effectively, it is used as a method of preventing a coating from being deposited where you don't want it (or the customer won't allow it).

To a certain extent, it is a non-value-added process. You spend time and money applying masking tape, masking compounds, lacquers, etc., only to peel them off and drop them in the trash when you are finished (masking is not that environmentally friendly a process). However, without masking, we could not:

- Precisely define the location of where we want the coating
- Protect vulnerable parts of the component
- Prevent buildup of lower quality deposits in turbulent areas, and
- Reduce notch sensitivity at coating transition points.

So, with these points in mind, as well as a few others we will discuss within this article, we really need to consider if masking should be kept anonymous or be more widely recognized for its heroic abilities.

Choosing the Right Masking for the Job

When thermal spraying, the first thought is often to turn to masking tape. This might be a suitable choice, but even then, how do you decide? Masking can have a significant cost impact on the thermal spray process as a whole and, therefore, ideally it should be used as efficiently as possible.

Tape masking is a flexible option, but other choices are available. The decision often depends on factors including:

- **Process energy levels.** Thermal and kinetic energy transfer from the flame and particle impingement.
- **Part geometry.** Conformability to the part being coated.
- **Accuracy of coating location.** Masking placement and reduction of bridging effects (more later).

Let's go with tape as a starting choice. If we pick the right tape for the job, we can mask just once to cover both the grit blasting and spraying procedures. In Fig. 1, we can see that although the tape apparently stood up to the blasting process, it was less than suitable for protecting the part during spraying.

In this test, we have come across a common problem where that elusive golden nugget — masking tape that can stand up to the aggressive energies of the high velocity oxyfuel spraying (HVOF) process — was not found. There are tapes in the

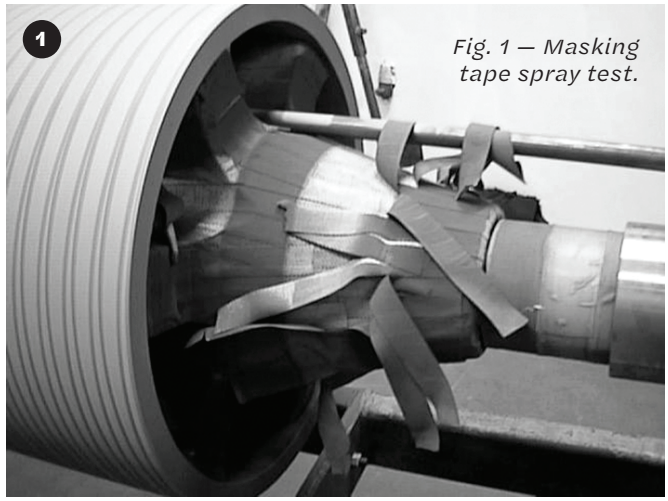


Fig. 1 — Masking tape spray test.

marketplace purporting to work in this environment, but it is certainly open to debate how well they work in every instance.

The Taping Process

Thermal spray masking tapes are typically constructed from a combination of silicone rubber, woven fiberglass, metal foils, and a silicone adhesive.

To ensure satisfactory adhesion, tapes made from these materials must be smoothed and pressed down strongly to create a good bond between the masking tape and the component's surface. There is nothing worse than having spent hours setting up your job only to see the masking tape gradually peel off during spraying. At what point do you abandon hope and stop? Figure 2 shows a gas turbine component that is in the process of being masked. The level of effort employed to produce a good bond can be seen by the surface markings on the tape (please avoid using the handle of a scalpel to do this).

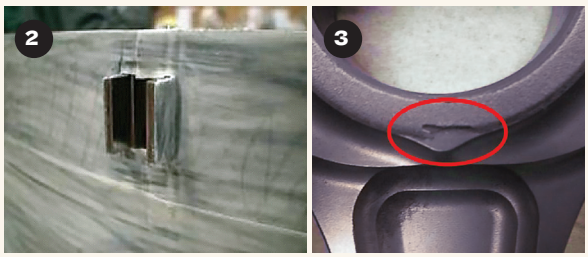


Fig. 2 — Tape masking for atmospheric plasma spray (APS).
Fig. 3 — Shadowed APS molybdenum-based deposit.

In Fig. 3, we can see the effects of poorly placed or detached masking. The coating has been unintentionally shadowed by detached masking tape during the deposition process. This creates an area of thin or poor-quality deposit, which often means the part will have to be reworked (this can be both a costly and technically demanding issue).

While shadowing can be an effective masking technique when used intentionally, metal shadow masks are often far more effective and durable than tape for this purpose.

Getting the Best Out of Tape Masking

We have already mentioned some instances where tape masking can go wrong. As well as rubbing down the tape with all of our might, there are other procedures that are worth considering to improve our level of success. Figure 4 shows a thermal barrier coating (TBC) on a gas turbine nozzle.

In this case, when the component was initially masked, two layers of tape were applied. Subsequently, during the spraying operation, the outer layer of tape burnt away, leaving the inner layer still in position. The application of a dual layer had, therefore, protected the part from overspray.

Tape supply companies can provide tape that is already double-layered. My personal preference is to apply one layer on top of the other as the random overlaps tend to improve the overall bond of the masking system.

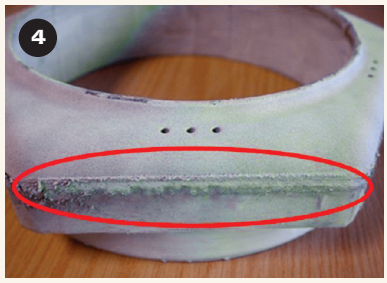


Fig. 4 — Multilayer taping methods.

Another important point is the buildup of ceramic coating on the tape — Fig. 4. The masking has done its job in protecting the part, but great care must be applied when removing it to ensure that the brittle coating is not chipped or de-bonded. The common practice for removing all masking tapes is to ensure the direction of removal is away from the applied deposit.

In this particular application, consideration can also be given to applying a line of weakness at the tape/coating interface using a tool such as a scalpel (care must be taken not to cause more harm than good). This method will introduce a preferential failure zone, which can reduce coating chipping.

It's Not All About Tape

As previously mentioned, tape is not the only solution. As applications get more challenging and the geometry of parts becomes more of an issue, application of lacquers and other liquid maskants can become a useful option. Just be aware that they will perform differently.

Advantages include a more-conforming mask that interferes less with the spray stream. Disadvantages can include a masking material that will withstand spraying but not grit blasting (there are some notable exceptions to this statement). These various liquid masking materials are chosen based on their suitability for the application at hand, so generalized rules of use are difficult to define.

Liquid maskants can be applied by dipping, brushing, and spraying. An interesting development has been the optimization of the controlled application of UV-curing resins via a robot — Fig. 5. This gives an exciting opportunity to remove some of the manual aspects of the masking procedure and improve the accuracy of masking placement.

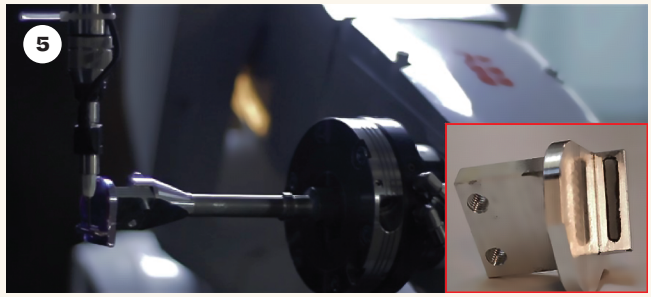


Fig. 5 — Robotic application of UV-curing resin together with finish-sprayed test component.

In Fig. 5, we see one of the exceptions to the norm, where the applied masking material stands up well to both blasting and spraying.

As positional sensing technology improves, we may soon find that some of the most arduous masking can be automated. For example, turbine blade cooling holes often require significant time and patience to mask. The holes can vary in size and location depending on the condition of the blade. One day soon, automation could handle this easily, reducing cost and improving quality.

Testing Your Metal

Heading toward the less flexible side of masking, we start to enter a different, more shadowy world.

Metal masking can be enormously useful when we need to produce very accurate delineations between masked and unmasked surfaces. Also, when using high-energy deposition techniques, such as HVOF or chamber processes (i.e., vacuum plasma spray), metallic masking is normally the only way to go.

Figure 6 shows the basic shadowing principle that is often (but not exclusively) utilized with metal masks. Here, you can see that positioning the mask above the surface of the area to be coated will produce a smooth transition between the coating and substrate. This has the advantage of reducing stress concentration and, therefore, improves local adhesion of the deposit and reduces notch sensitivity effects. Lack of direct contact between the active mask and the part being coated also reduces possible bridging of the deposit and subsequent chipping.

The cost of the manufacture of metal masking can be viewed as somewhat prohibitive, but this has to be balanced against the necessities of the application, as well as the potential gains it can provide. For example, Fig. 7 shows how this type of masking can be used to prevent the negative effects of turbulence and bounce off adjacent vertical surfaces. Effectively, the mask is removing the potentially poor coating from the equation as well as providing an accurate coating position.

If cost is your concern, then don't forget what the humble nut and bolt can do for you. The use of a properly sourced bolt will also give the added advantage of a shadow mask so that a professional job can be delivered to the customer — Fig. 8. At the end of the day, that's what masking is all about!

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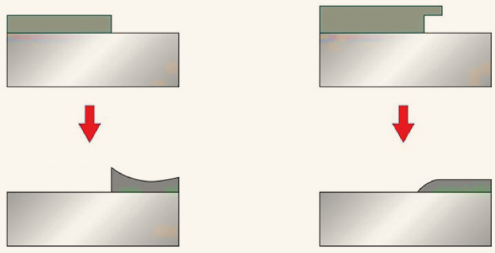

Fig. 6 — Contact vs. shadow masking techniques.

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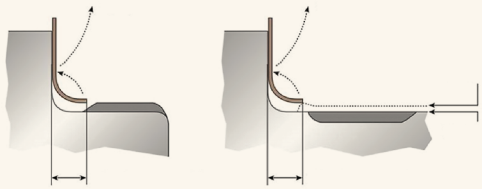

Fig. 7 — Reducing spray bounce effects using shadow masking.

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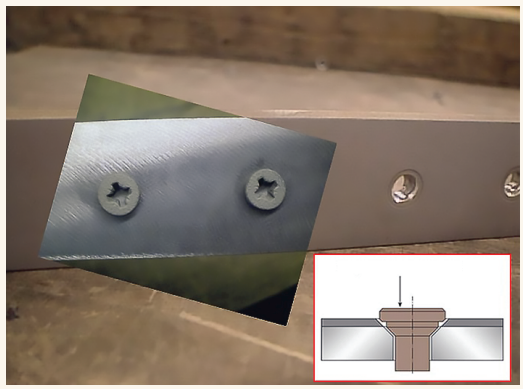

Fig. 8 — Plug masking for HVOF coating application.

Conclusion

Masking is an integral part of the thermal spray process and should be treated as such. Care must be taken over the specification of the masking materials used, their placement on the part being sprayed, the design of the masking technique with respect to the relevant spray process, and, last but not least, its final removal (ensuring that our precious coating is not damaged near the very end of a costly process).

Spraying is a dynamic process. Although we have reviewed some of the basic masking methods, there are always new techniques to be learned and optimized to protect the component effectively.

One thing is for sure: Without masking, we would not have a satisfactorily surface-engineered product. So, I guess masking is a little bit of a superhero after all.

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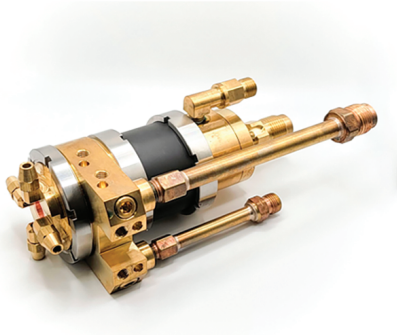

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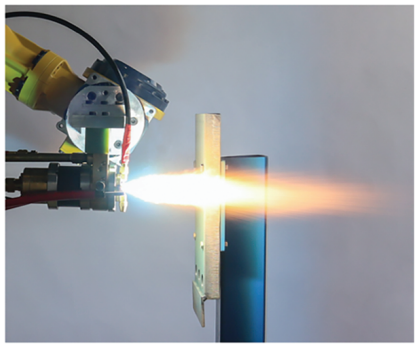

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