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On the cover: Soldier installing a metal 3D-printed wheel bearing part on an M113 armored personnel carrier. (Photo courtesy of SPEE3D.)

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Published by the International Thermal Spray Association, a Standing Committee of the American Welding Society

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Mollie Blasingame
Chair

Happy 2024 to our ITSA members and readers!

We are kicking off the first quarter of the year excited to announce the ITSA 2024 Annual Business Meeting and conference details. ITSA will meet November 5–7 in Miami, Fla. Please save the date. The American Welding Society (AWS) will be hosting us at their global headquarters building. The one-and-a-half-day agenda will include the ITSA Executive Committee meeting, ITSA Annual Business Meeting, AWS C2 Committee on Thermal Spraying meeting, and visits to Florida International University's (FIU) new Cold Spray and Rapid Deposition Laboratory (ColRAD) and the school's Plasma Forming Laboratory. It will be interesting to tour and see what research is being conducted at the FIU labs. We are also working with the Association for Materials Protection and Performance (AMPP) on presentations for this year's conference.

And while the ITSA Executive committee is working on the 2024 conference in Miami, we are also looking ahead to 2025 when we will again partner with AMPP for a potentially even larger event.

If you would like to present at our 2024 event in Miami, please reach out to ITSA Program Manager Adrian Bustillo at *abustillo@aws.org*. We appreciate your feedback and value you as a member of our ITSA family.

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

Mollie Blasingame, chair, Superior Shot Peening & Coatings
Kirk Fick, vice chair, Cincinnati Thermal Spray Inc.

EXECUTIVE COMMITTEE (previously mentioned officers plus the following)

Ana Duminie, North American Höganäs
Jim Ryan, TechMet Alloys
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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 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 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*.

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Attend the ITSA 2024 Annual Meeting

In conjunction with Florida International University (FIU) and the Association for Materials Protection and Performance (AMPP), the International Thermal Spray Association (ITSA) will hold its 2024 Annual Meeting at AWS World Headquarters, Miami, Fla., on November 6 and 7.

The 2024 Annual Meeting will feature a visit to FIU's Engineering campus, home to the university's new Cold Spray and Rapid Deposition Laboratory.

A partnership with AMPP sets the stage for presentations and possible sponsorship opportunities.

This one-and-a-half day event also features meetings of the AWS C2 Committee on Thermal Spraying and ITSA executive committee. A formal ITSA business meeting will also be held.

Attendees should plan to arrive in Miami on November 5 and depart following lunch on the afternoon of November 7.

Additional information about this event will become available in the coming months. Updates on the 2024 Annual Meeting will be posted on the newly revised ITSA website at *thermalspray.org*.

Kennametal Partners with American Precision Museum

Kennametal Inc., Pittsburgh, Pa., a machinery parts manufacturer, has partnered with the American Precision Museum (APM), Windsor, Vt., home to a large collection of historically significant machine tools.

"Our partnership with APM is a natural fit to tell Kennametal's 85-year story of expertise and innovation across industries while also showcasing where we're headed next," said Keith Mudge, Kennametal vice president of sales — Americas.

As part of this collaboration, APM is showcasing the company's tools in its makerspace, where visitors can explore and learn about different machining solutions. Kennametal will also contribute to historical exhibits showcasing the work of the company's founder, metallurgist Philip McKenna, and its longstanding legacy in the manufacturing industry overall.

"It is particularly fulfilling to be supported by a world-class innovator of machining solutions," said APM Chair Lee Morris. "We look forward to presenting the story of Philip McKenna's development of tungsten carbide, and we are very fortunate to have Kennametal's ongoing support as we attempt to inspire next generations to develop careers in manufacturing."

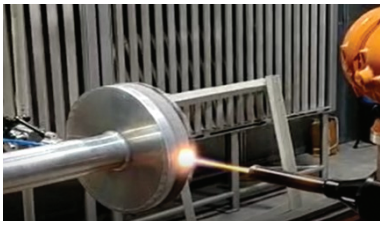
Flame Spray North America Grows Operations

Flame Spray North America, a thermal spray coatings manufacturer located in Fountain Inn, S.C., is expanding its operations in Laurens County, S.C. The company's $2.5-million investment will create 40 new jobs.

The expansion includes the addition of advanced thermal spray coating technologies for servicing industrial gas turbine components and technological improvements for the current facility.

"Flame Spray North America is thrilled to continue to grow in Laurens County, South Carolina," Flame Spray North America President and CEO Marco Prosperini said. "We appreciate the support of Laurens County and South Carolina and are deeply grateful for the dedication of our employees and the commitment of our customers."

ARCI Scientists Develop HVAF-Sprayed Coatings, Hard Chrome Plating Alternative



The high-velocity air fuel (HVAF) spray process performed at ARCI.

Scientists from the International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad, India, an autonomous institution of the Department of Science and Technology, created a new technique of synthesizing thin, hard surface coatings by high-velocity air fuel (HVAF) spraying. The technique has the potential to emerge as an environmentally friendly, safer alternative to hard chrome plating (HCP) used on car parts, tools, and kitchen utensils.

Chrome plating is carcinogenic in nature. This initiated the researchers' search for a safer, environmentally friendly alternative with an equivalent or superior wear resistance with a crack-free coating.

The ARCI scientists carried out the synthesis of thin, hard coatings of a composite alloy of tungsten, cobalt, and chromium (WC-10Co-4Cr) by HVAF spraying. Thin coatings were deposited via torches with different capacities and by employing different nozzle sizes.

Superior sliding wear performance was noticed with HVAF-sprayed, thin WC-10Co-4Cr coatings against conventional HCP. Corrosion studies showed that the new technique could be a better alternative to HCP for heavy-load applications like hydraulic shafts, valves, piston rods, balls, and more.

The surface roughness of the as-deposited, thin, thermal-sprayed WC-10Co-4Cr coatings was found to be an order of magnitude higher than that of HCP.

Further, the coating can be deposited in the as-machined condition to achieve a smooth surface with about a 50-µm coating thickness. This significantly reduces the postcoating finishing operations, an outcome that reduces the processing

and raw material cost significantly with better wear resistance than HCP.

The study, published in the *Journal of Thermal Spray Technology*, volume 32, issue 8, provides the full details of the experiment.

Newly Developed Material Protects Fusion Reactor Walls

Engineers at the University of Wisconsin (UW)–Madison, Madison, Wis., have used a spray coating technology to produce a new workhorse material that can withstand the harsh conditions inside a fusion reactor.

(From left) Engineer Jeremiah Kirch, Postdoctoral Researcher Mykola Ialovega, and Assistant Scientist Marcos Xavier Navarro-Gonzalez work on the implementation of tantalum coatings as a plasma-facing material for the WHAM device, which is pictured in the background. (Photo courtesy of Mykola Ialovega.)

The advance, detailed in a paper published recently in the journal *Physica Scripta*, could enable more-efficient compact fusion reactors that are easier to repair and maintain.

"The fusion community is urgently looking for new manufacturing approaches to economically produce large plasma-facing components in fusion reactors," said Mykola Ialovega, a postdoctoral researcher in nuclear engineering and engineering physics at UW–Madison and lead author on the paper. "Our technology shows considerable improvements over current approaches. With this research, we are the first to demonstrate the benefits of using cold spray coating technology for fusion applications."

The researchers used a cold spray process to deposit a coating of tantalum, a metal that can withstand high temperatures, on stainless steel. They tested their cold spray tantalum coating in the extreme conditions relevant to a fusion reactor and found it performed very well. Importantly, they discovered the material is exceptionally good at trapping hydrogen particles, a feature that is beneficial for compact fusion devices because it helps maintain power in the plasma.

Ialovega conducted experiments on the coated material at facilities at Aix Marseille University in France and Forschungszentrum Jülich GmbH in Germany. During these experiments, he found that when he heated the material to a higher temperature, it expelled the trapped hydrogen particles without modifying the coatings — a process that essentially regenerates the material so it can be used again.

"Another big benefit of the cold spray method is that it allows us to repair reactor components on site by applying a new coating," Ialovega said. "Currently, damaged reactor components often need to be removed and replaced with a completely new part, which is costly and time consuming."

The researchers plan to use their new material in the Wisconsin HTS Axisymmetric Mirror (WHAM). The experimental device is under construction near Madison and will serve as a prototype for a future next-generation fusion power plant that UW–Madison spinoff Realta Fusion aims to develop. Housed in the Physical Sciences Laboratory, the WHAM experiment is a partnership between UW–Madison, Massachusetts Institute of Technology, and Commonwealth Fusion Systems.

The researchers are patenting their technology through the Wisconsin Alumni Research Foundation. — Adam Malecek, University of Madison–Wisconsin

Kymera International Buys Metallisation Ltd.

Kymera International, Research Triangle Park, N.C., a global specialty materials and surface technologies company, has acquired Metallisation Ltd., a UK manufacturer and worldwide supplier of thermal and metal spray equipment, consumables, wires, and powders.

Metallisation will contribute to the continued growth of Kymera's Surface Technologies business and its ability to deliver turnkey engineered solutions to global Tier 1 and original equipment manufacturer customers, specifically in the UK and the European region. This acquisition also expands Metallisation's product offerings, enhancing its market positioning and growth opportunities.

"The acquisition of Metallisation aligns with our strategic initiatives and strengthens Kymera's position in the thermal spray sector," Kymera CEO Barton White commented. "We will now be able to provide our aerospace customers with a vertically integrated offering that includes equipment, materials, and application services."

ATCAM Expands Facility

ATCAM, a thermal spray coating and machine shop in Little Chute, Wis., has begun work on a 30,000-sq-ft addition to its facility.

The new space will include additional cranes, a loading dock, an office, and shop space. The addition is expected to be completed by summer 2024.

"With this expansion, ATCAM will be able to expand the services we provide for current customers as well as attract new customers along the way with the additional processes and machinery that we will be adding," ATCAM Former President Peter Andres said in an article by Ashley Kaster on Fox 11 News.

Andres's son, Nate, recently assumed the role of president of ATCAM and is now overseeing operations.

The company expects to hire more employees once the addition is completed.

EVENTS CALENDAR

AMPP Annual Conference + Expo

March 3–7
New Orleans, LA
ace.ampp.org/home

Powder Coating Week 2024

March 11–13
Orlando, FL
conference.powdercoating.org

ITSC 2024: Advancing Thermal Spray Technology

April 29–May 1
Milan, Italy
www.asminternational.org/itsc-2024

Coatings for Non-Coating Inspectors

April 30–May 1
Houston, TX
ampp.org/events/coatings-for-non-coating-inspectors

CSAT 2024

June 11–12
Worcester, MA
coldsprayteam.com/csat-2024

AMPP Gulf Coast Conferences

August 5–7
Houston, TX
ampp.org/events/gulf-coast-conference

North American Cold Spray Conference

Sept. 10–11
Boucherville, Canada
www.asminternational.org/nacsc-2024

International Materials, Applications & Technologies: IMAT 2024

Sept. 30–Oct. 3
Cleveland, OH
www.asminternational.org/imat-2024

International Thermal Spray Association Annual Meeting

Nov. 6–7
Miami, FL
thermalspray.org

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BY LACEY REAMES

Exploring Three TUNGSTEN CARBIDE THERMAL SPRAY COATINGS and Their Uses

Tungsten carbide is used in many different applications, from wedding rings to drill bits. As an integral part of the coating world, tungsten carbide coatings help many heavy industrial companies stay up and running longer. However, not all tungsten carbide coatings are the same. There are many different chemical compositions of tungsten carbide thermal spray coatings with varying percentages of tungsten carbide and various metals to tailor the coating for different environments.

Tungsten carbide itself is a ceramic and, therefore, very hard but brittle. With the addition of metals, like cobalt and nickel, users can increase the ductility of the overall coating and improve its performance. There are countless different formulas and compositions, but the ones briefly explored in this article are tungsten carbide cobalt, tungsten carbide nickel, and tungsten carbide cobalt chrome.

Tungsten Carbide Cobalt

Tungsten carbide cobalt (88WC 12Co) is a wear coating that helps with sliding wear, abrasion, and fretting resistance. As a rule, thermal spray coatings don't typically handle impact or point loads well, but tungsten carbide cobalt does offer some impact wear resistance. Tungsten carbide cobalt is not very corrosion resistant; therefore, it is best in dry environments.. One great application for this material is feed rolls, whether for paper, sheet metal, or other products.

Tungsten Carbide Nickel

Tungsten carbide nickel (90WC 10Ni) is also a wear coating but offers more corrosion resistance at a lower hardness. It also resists sliding wear, abrasion, and fretting. Since this

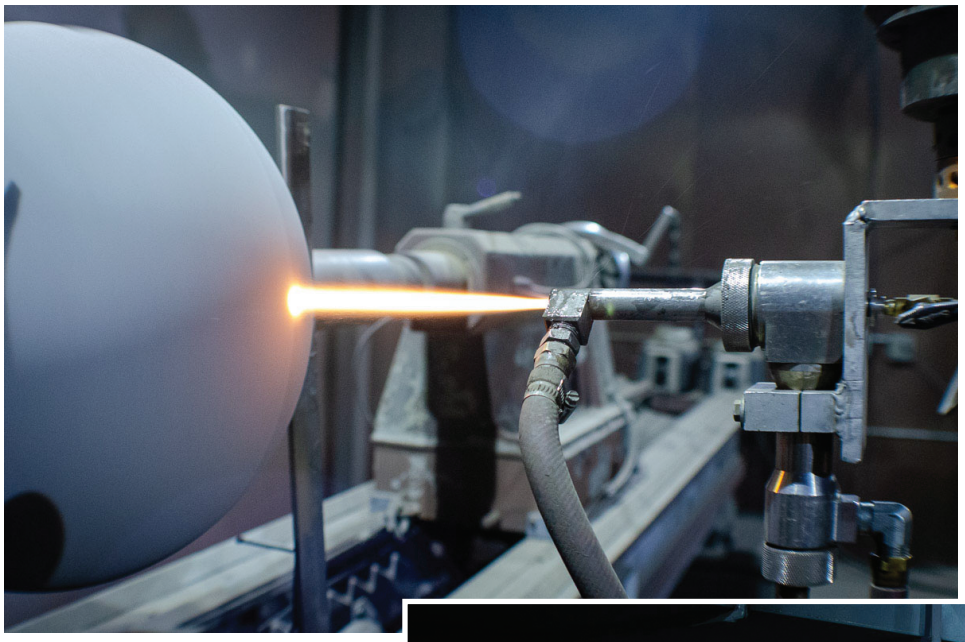

Fig. 1 — Tungsten carbide coating to prevent wear on valve balls.

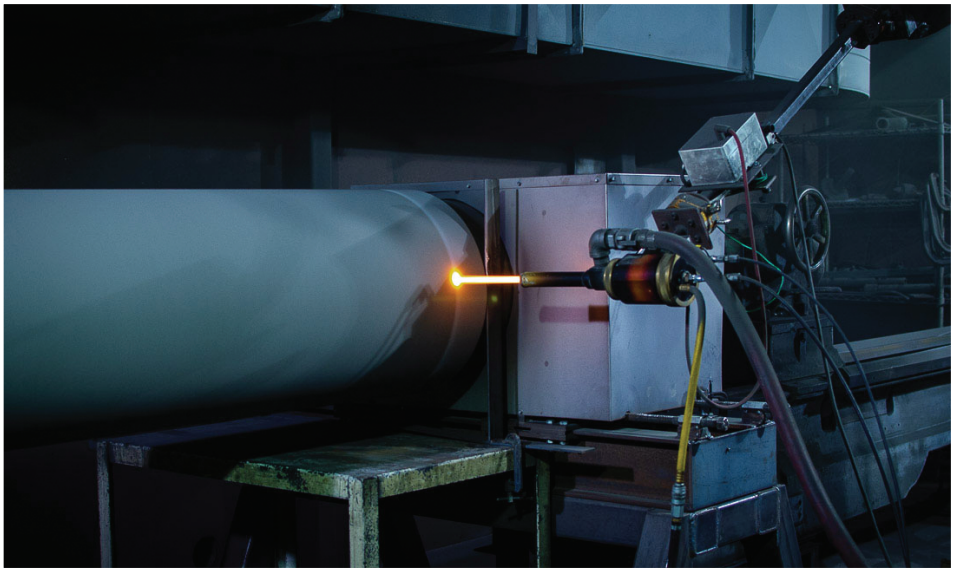

Fig. 2 — HVAF tungsten carbide coating for large rolls.

tungsten carbide does not contain cobalt, it will not degrade in a radioactive environment. It works great for ball and gate valves among other applications — Fig. 1.

Tungsten Carbide Cobalt Chrome

Tungsten carbide cobalt chrome (86WC 10Co 4Cr) is a wear and corrosion-resistant coating often used as a hard chrome plating alternative. It is harder than both tungsten carbide cobalt and tungsten carbide nickel, reaching up to the 70 HRC range, and excels in abrasion wear resistance and erosion fretting resistance. Tungsten carbide cobalt chrome is the one our shop uses most of the three and can also be applied via the high-velocity air fuel (HVAF) process creating a much more ductile and harder coating with superior corrosion resistance than high-velocity oxygen fuel applied tungsten carbide cobalt chrome — Fig. 2.

Different Tungsten Carbide Coatings for Different Applications

Each of the previously mentioned tungsten carbide coatings will provide wear resistance and extend the service life of parts. The key to finding the best solution for your piece is matching the right chemical composition to the right operating environment. For instance, some coatings will do better than others in wet or corrosive environments. Temperature limitations are also another factor to watch for in coating selection. It is often best to work with a reliable thermal spray company to determine which one is right for your project.

LACEY REAMES *(lreames@htscoatings.com)* is proposal engineer, HTS Coatings, Madison, Ill.

BY STEVE CAMILLERI

COLD SPRAY

In Remote Locations and Austere Environments

A look at how cold spray and additive manufacturing are being used by the military

Samples of parts produced from different metals in remote locations.

Additive manufacturing (AM) represents a paradigm shift in the way that parts and products are being produced and introduced into the marketplace. It is now possible to accomplish AM not only in a manufacturing setting but in remote locations at the point of need, alleviating the logistics burden on the supply chain. Additionally, the time from conceptual design through the prototype stage and ultimately to the final test, evaluation, and qualification before production can commence is greatly reduced, resulting in substantial cost savings.

Cold Spray Technology

Cold spray (CS) is a materials consolidation process where micron-sized particles of a metal, ceramic, and/or polymer are accelerated through a spray gun fitted with a de Laval rocket nozzle to form a coating or a near-net-shaped part, by means of ballistic impingement (Refs. 1, 2). The feedstock powder particles are carried within a heated high-pressure gas (i.e., air, nitrogen, helium) such that they exit at supersonic velocities and consolidate upon impacting a suitable surface. The

Fig. 1 — A SPEE3D printer was used on a U.S. Navy ship during a REPTX event to manufacture military maritime parts both in port and at sea. (Photo by Brett Harro.)

CS process has been developed to deposit a wide variety of engineering materials, including metals, steels (carbon and stainless), titanium, aluminum, magnesium, nickel alloys, zinc, tin, copper, tantalum, niobium, monels, brasses, and bronzes. Even gold and silver have been used in the CS process. Cermets, carbides, polymers, and/or combinations of these materials are routinely cold sprayed, including CrC-Ni, WC-Co, and many more with near theoretical density.

It is important to note that CS is considered an AM process and has been adapted to form 3D parts, as well as coatings (Refs. 3–5). Dr. Victor Champagne and his team at the U.S. Army Research Laboratory, in collaboration with the former United Technologies Research Center (now Raytheon Technology Research Center), introduced the first cold spray additive manufacturing (CSAM) part on the Patriot missile in 2018. Since then, significant advancements have been made toward the development of software specifically designed for CSAM.

SPEE3D CEO Byron Kennedy and Chief Technology Officer Steven Camilleri had worked together for more than 15 years when they founded the company in 2014. During that time, they encountered a persistent challenge: sourcing metal parts. From supply chain issues to part obsolescence, they continued to face a battery of obstacles and struggled to find an efficient way to keep equipment up and running. To simplify and accelerate the metal AM process, they began to harness the true potential of CS and created an automated CSAM process, which allows the user to avoid melting or sintering metal powders. Melting or sintering the powder can create tiny cavities in the part, reducing its density and increasing the likelihood of cracking or fatigue failure over time. The high-velocity impact created by automated CSAM produces a denser part with lower porosity, as well as enhanced mechanical properties that improve part and tool reliability over a longer lifespan.

CSAM Out at Sea

In August 2022, the U.S. Navy hosted the first-ever Repair Technology Exercise (REPTX) event to identify, validate, and implement new technologies, including AM, to help reduce supply chain issues, perform maintenance operations more efficiently, and limit travel time back to port. It was conducted as part of Advanced Naval Technology Exercise (ANTX) Coastal Trident 2022, which had more than 60 naval, academia, and industry participants. The trial consisted of a series of technical demonstrations, field experiments, and exercises, both discussion and operations-based. The WarpSPEE3D printer showcased at the event was stated to be the first to ever print parts successfully on a U.S. Naval ship — Fig. 1. The part printed

Fig. 2 — AMC technicians took a wheel bearing from design to print.

was a bronze anchor that was produced five times while the vessel was engaged at sea. Parts were printed with the same results and within just six minutes each time. In addition, the SPEE3D team assisted other companies with their trials, helping print a wide range of applications, including pressure fittings for pipes, protective boxes for naval equipment, and manufacturing mechanisms for robotic arms.

"Our goal during REPTX was to successfully test WarpSPEE3D's deployable technology to print maritime military parts on demand and in various sea conditions. We're thrilled the results are favorable and that SPEE3D is the world's first to print parts on a ship," Camilleri said. "We understand the operational, economic, and supply chain issues the military faces and look forward to continuing to work with U.S. Defense to help solve some of these challenges."

Fig. 3 — An AMC technician at the Bradshaw Training Area.

Fig. 4 — The Australian Army conducted a 12-month trial of 3D metal printing in the country's remote Northern Territory.

Point-of-Need Manufacturing for Cold Weather Combat Effectiveness

On December 4–8, 2023, the Office of the Secretary of Defense Manufacturing Technology (ManTech) Program featured technologies that will enable combat effectiveness in extreme temperatures. The event was supported by the U.S. Army Combat Capabilities Development Command and showed technologies recommended by the U.S. Department of Defense's Manufacturing Innovation Institute member companies that previously competed in a Point-of-Need Manufacturing Challenge held in March 2023. Winners were chosen through an open solicitation after proposing solutions to the Department's operational constraints in extreme cold temperatures.

According to a public report issued December 18, 2023 (Ref. 6), "SPEE3D's 3D metal printing technology is an industry-proven, military-tested, expeditionary, all-in-one solution. The system uses existing cold spray technology to create complex 3D parts quickly. SPEE3D's technology has been demonstrated in operations in hot and hot-humid environments, including work with the United Kingdom and Australian militaries, the U.S. Navy Repair Technology Exercise 2022, and the U.S. Army's Project Convergence 2022. The project goal is to successfully 3D-print metal parts in a sub-freezing environment that is equivalent in quality to the same parts printed, on the same technology, in a lab environment."

Operating In the Remote Australian Bushland

The Australian Army is rapidly developing its metal manufacturing capability with metal 3D printing technology. The Australian Army made a $24-million investment in a pilot of SPEE3D technology that was conducted in February 2020 with a 12-month trial of the WarpSPEE3D tactical printer. The trial was designed to test the feasibility of deploying metal 3D printing as a capability both in barracks and in the field. The printer uses patented CS technology that enables fast and cost-effective metal part production. It can print large metal parts up to 89 lb (40 kg) at a record rate of 0.220 lb (100 g) per minute.

Several field trials resulted in more than 50 case studies of printable parts and demonstrated that the printer can operate in remote Australian bushland and the program was extended in 2021 to verify initial results.

SPEE3D worked closely with the Australian Army to train the first military additive manufacturing cell (AMC) technicians who specialize in the production of 3D metal printed parts, from design to printing to machining, heat treatment, and certification — Figs. 2, 3. In the remote bushland of the Bradshaw Training Area, located in the Northern Territory, the AMC technicians recently tested the WarpSPEE3D tactical printer as part of its toughest trial yet. The printer was transported more than 372 miles (600 km) from the base, over rough terrain, to operate in hot and dusty conditions for three weeks — Fig. 4.

Conclusion

The ability to maneuver over complex geometries and to produce near-net shapes is a significant advantage of CS (Ref. 7) that is just beginning to be realized by the industrial community. Cold spray is often argued as not fitting the definition of AM and, as such, is often dismissed as a true AM process. However, it has been used to produce near-net-shaped parts for a variety of applications that are far superior to conventional and/or competing AM techniques when all aspects of the process are taken into consideration, especially when operating in remote locations and in austere environments.

The choice of material, the complexity of the geometry, the availability of feedstock powder, as well as the intended application are all important factors that weigh into the decision to select the CS process to fabricate parts. While the CS process is not as precise as a powder bed laser sintering process, CS is capable of high deposition rates of metals such as aluminum or titanium and for those that are highly reactive at high temperatures, such as magnesium which cannot be produced by laser sintering (Ref. 8). The CS process can easily be manipulated robotically to accommodate highly complex geometries. Additionally, it usually has no limit on thickness or length, as long as the compressive residual stresses imparted by the process are managed.

The hardware is relatively straightforward, and CS doesn't require extensive training to operate proficiently, the utility requirements are minimal, especially when compared to conventional casting and forging, as well as competing direct-energy deposition (DED) techniques. CS has high deposition rates as compared to other AM processes, high combinations of strength and ductility, and it is cost effective making it a great choice not only for manufacturing but also for the battlefield and operating in harsh austere environments. CS doesn't require the melting of feedstock and the consolidation of powder into a 3D printed part is accomplished in the solid state.

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Cold Spray System Cuts Costs and Simplifies Supply Chain

The TKF 1000 modular additive manufacturing system is engineered to reduce lead times, maximize uptime, cut material costs, and enhance performance. The system is a turnkey robotic solution. It can be used to produce complete parts and for reloading and coating operations. The spraying head is integrated into a robot in a secured robotic cell. Features include large-scale metal additive manufacturing, synchronized six-axis robotics, servo positioning, Titomic Kinetic Fusion® (TKF) controls, and an intuitive touch panel interface. The system produces large multimetal barrels that are lighter and offer better corrosion and erosion performance than traditional techniques. The tooling produces stronger, lighter, thinner, and corrosion-resistant near-net shape faceplates with reduced welding, assembly, and lead times. Designed for easy operation and user experience, the system enclosure includes scratch-proof polycarbonate viewing panels, fully insulated composite panel cell walls, an automated bi-parting loading door with a sealing system, and easy access points for connecting services. The downdraft extraction area removes particles and operating gas via the floor and features removable nonslip grating panels and a ducted powder feed area for reloading and continuous operation. Users can connect to existing dust collectors with signal interfacing. The system also includes a plug-and-play integrated housekeeping vacuum with a 5-m maximum antistatic vacuum hose.

Titomic
titomic.com / info@titomic.com

Report Analyzes Thermal Spray Robots Market and Prospects for 2030

Thermal Spray Robots Market by Product Type, Application and Region — Global Market Analysis and Forecast (2019–2030) covers various aspects of the thermal spray robots market, including market dynamics, competition, growth avenues, challenges, and regional variations. Furthermore, it is intended to help stakeholders make critical decisions that can shape their strategies and endeavors in the market. The report demonstrates factors propelling the market's growth, dissecting consumer preference shifts and technological breakthroughs driving the demand for thermal spray robot products. Simultaneously, it introduces the major players in the thermal spray robots market and their strategies, offering insights into what makes them thrive. This insight-rich analysis is meant to guide others on their path forward, whether to navigate the competition more effectively or find inspiration in successful strategies. The report segment analysis chapter provides critical insights into the market's numerous subsegments, including year-on-year growth estimates. This allows readers to discover and investigate potential market development areas. The global thermal spray robots market is segmented into 4-, 5-, 6-, and 7-axis based on product type. Based on application, the thermal spray robots market is segmented into automotive, electronic electrical, metal, medicine, rubber and plastics, food, and others.

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Thermal Spray Report Highlights Lucrative Business Opportunities

Thermal Spray Coatings Market by Materials (Ceramics and Metals & Alloys), Process (Combustion Flame and Electrical), End-Use Industry (Aerospace, Automotive, Healthcare, Agriculture, Energy & Power and Electronics) and Region — Global Forecast to 2028 posits that the global thermal spray coatings market is projected to grow from $10.4 billion in 2023 to $14.3 billion by 2028 at a compound annual growth rate of 6.5%. The report defines, segments, and projects the thermal spray coatings market size based on process, material, end-use, and region. By process, the combustion flame segment is estimated to be the largest thermal spray coatings market segment from 2023 to 2028. By material, ceramics is estimated to be the market's largest segment. Based on end-use, aerospace is estimated to account for the largest share during the forecast period. The 230-page report strategically profiles the key players and comprehensively analyzes their market share and core competencies. It also includes drivers such as growing demand from the healthcare industry, reduced maintenance cost of thermally sprayed parts, thermal spray substituting electroplating processes, and a boom in the aerospace Industry.

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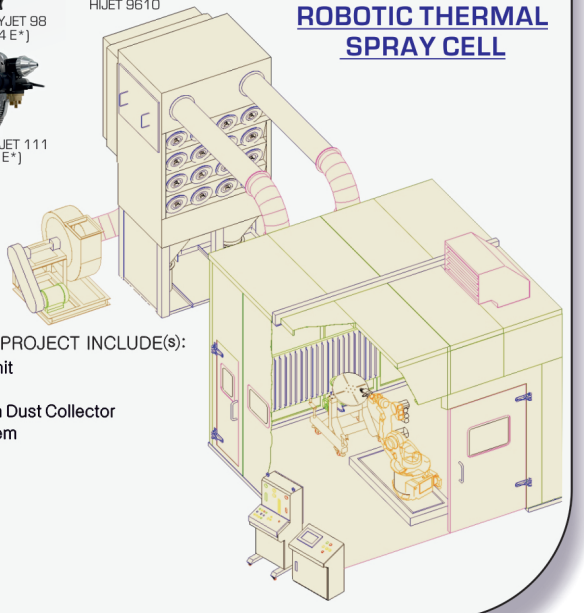

A ROBOTIC COATING PROJECT INCLUDE(s):

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