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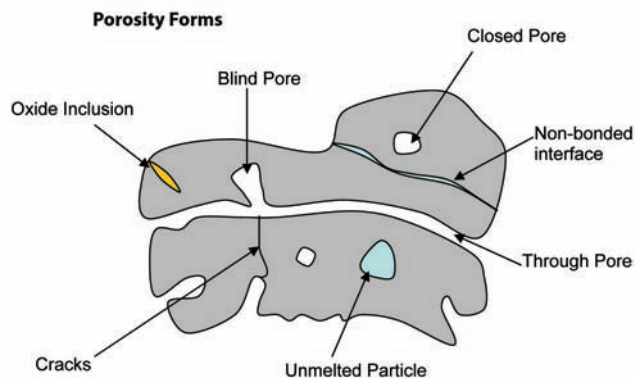
First Quarter 2012

The Importance of What's Not There; Porosity

Richard S. Brunhouse, Peter Foy, Dale Moody
Plasma Powders and Systems Inc.

When a fabricator starts into the world of Thermal Spray, he may find himself considering something new; porosity. With machining, stamping, forming or joining, porosity is rarely an issue. Welding is the one area a fabricator may have an issue with porosity.

Porosity, also referred to as void fraction, is a measure of the void space (or empty space; i.e. nothing) in a material. It is typically characterized as a percentage, between 0 and 100%, of the volume of voids within the total volume. It can take on a number of forms, open, closed, connected elongated, etc.

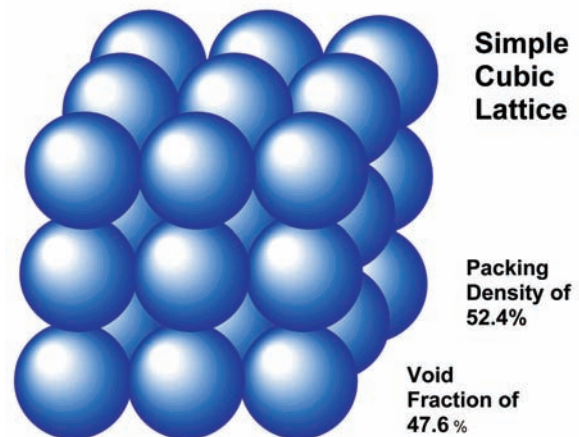


We're probably all familiar with porosity around the household. The sponge mop head with its open-cell structure, a foam mattress with a closed cell structure, Swiss cheese with its random cells, and a roll of bubble-wrap with its layered cells.

Porosity is a normal feature of thermal spray processes. Thermal spray is a very dynamic process, involving thermal, kinetic and chemical process. There are some special issues with porosity in thermal spray coatings.

To understand the porosity associated with Thermal Spray processes, consider how the build is made. A coating is developed by the build-up of semi-molten spherical and irregular particles. The build can be considered to follow the same type of dynamics associated with packing of spheres in a volume.

For example, assuming that the powder is spherical, of uniform size and deposited such that a simple cubic lattice is developed, the packing density for this structure is 0.524. The porosity or void fraction is therefore 0.476 or 48%.



If instead of a simple cubic lattice arrangement, a hexagonal or cubic close pattern is assumed, the calculated packing density is 0.7045, giving a porosity void fraction of 0.2955 or 30%.

Continued Page 4

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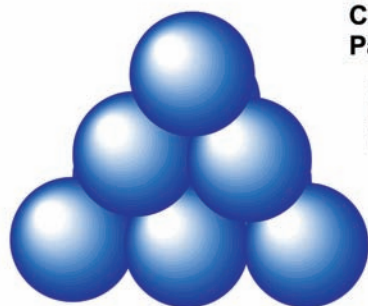
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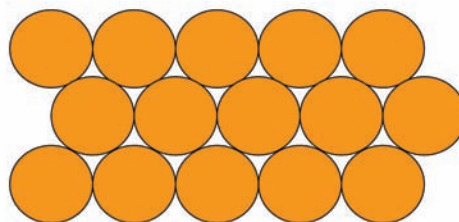
In the study of packing of spheres in a volume, it is possible to calculate the packing density of randomly stacked spheres in a volume. In this case, the packing density is 0.640, giving a void fraction of 0.360 or 36%.¹ Generally, anything done to the coating from this point (non-spherical particles, non-uniform size, particle compression, etc.), reduces the porosity. For example, the porosity of closely packed, circular flat disks is 9%. The upper limit for porosity or void fraction for a thermal spray build is probably around 30%.

There are some other factors regarding the porosity in Thermal Spray Coatings.

First, unlike the porosity in products such as Swiss cheese, which is uniformly distributed throughout, no matter which way you slice it, porosity in a thermally applied coating is

layered. It is a lamellar structure. Think of the cross-section of a roll of bubble wrap where you have both closed cells and connected cells. Thermal spray builds layered coatings or structures with semi molten particles, often trapping air or process gasses between particles into both closed singular cells and connected cells. In addition, the voids can take on a number of forms including cracks.

Splat Packing



**Packing
Density of
91%**

**Void Factor
of 9%**

Second, thermal spray porosity is normally measured using a destructive test. A sample or coupon is prepared using the specified spray parameters and then destroyed in the measurement. Porosity of the end product is normally not determined.

Third, while porosity is a volumetric condition, in Thermal spray coatings, it is usually measured as a two-dimensional property (Area porosity)

In some thermal spray operations, porosity is essential. For example, the hydroxyapatite (HA) coatings used for prosthetic implants depend on the open-pore structure for attachment by bone growth. For a Thermal barrier coating (TBC) used in gas turbines, some of the insulating properties are due to the porosity of the coating which runs from 7% to 15%.

On the other hand, porosity can be a problem. TBC porosity can jeopardize the structural integrity of a coating. Corrosion protection coatings can fail if the porosity allows a direct path to the substrate. Highly polished coatings such as the tungsten carbide coating of plungers used in the manufacture of bottles can lead to flaws in the finished product.

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offers up to three Graduate Scholarships **worth \$2,000.00 each.**

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Porosity may not be an obvious issue, and yet it is still specified and evaluated. Why? Right or wrong, it is one of the most common quantitative parameters used to characterize the microstructure of a thermally sprayed deposit. This is even though "the total porosity of the deposit does not have significant meaning from the viewpoint of quantitative interpretation of deposit properties".²

Essentially, we measure the porosity of a thermally sprayed Coating because we can; it provides us a measure of comfort that the coatings are being applied according to the requirements.

The measurement of porosity is easy to understand but difficult to carry out. A number of means are available to measure porosity but the most popular for thermally sprayed coatings is Light Microscope Image Analysis. Besides porosity, this procedure allows for checking the thickness, interfaces, unmelted particles, any detachment and any contamination.

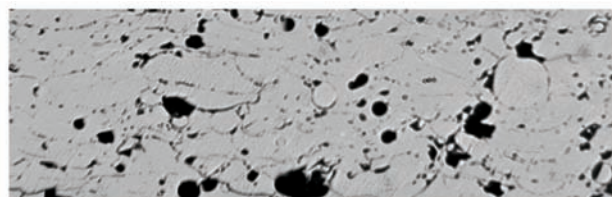
ASTM E2109-01 (2007), "Test Methods for Determining Area Percentage Porosity in Thermal Sprayed Coatings" covers procedures to perform porosity ratings on metallographic specimens. Specimens are prepared in accordance with ASTM E 1920.

While this is an area measurement, it is essentially equal to the porosity of the volume as long as the pores are small and uniformly distributed.

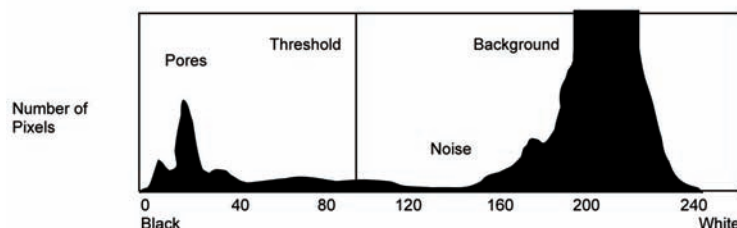
Preparation of the coupon includes sectioning, cleaning, mounting grinding and polishing prior to microscopic inspection. Care is essential during preparation to avoid adversely influencing the results by smearing of material into voids or detaching singular particles.

As noted earlier, Optical Microscopy is a destructive test and is therefore not performed on the end product. The frequency of testing will vary according to the need. In some cases, a single qualifying sample is sufficient. In other cases, a test coupon is sprayed concurrently with each part being coated.

Porosity determination can be by comparison to standard images or by the use of automatic image analysis equipment. One automatic image analysis technique is to first develop a gray scale image of the specimen, generate a gray scale histogram of the image, establish a gray scale threshold and determine the area percentage (percentage of pixels in the image) that is less than that threshold.



Gray Scale



Histogram

What about controlling or adjusting porosity? Both the Thermal Spray process and the powder morphology can influence the porosity of the final coating structure. For example, the porosity of a coating from powder that is fused and crushed is generally lower than the porosity of a coating from powder that has been agglomerated and sintered.³ Also, HVOF coatings generally have a porosity that is lower than a coating produced by an electric arc process.⁴ For example, a Tungsten/Carbide/Cobalt 83/17 coating with less than 1% porosity was achieved using a Hipojet 2700 air cooled HVOF gun.

continued on page 6

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continued from page 5



Post processing can also reduce coating porosity. In a sintering process, metal or ceramic particles are raised to an elevated temperature where, through diffusion driven by the reduction of surface energy, the pores reduce in size, leading to an overall decrease in porosity.

In summary, porosity is used to characterize and qualify the microstructure of thermally sprayed coatings, it can be controlled and adjusted within some limits, there are difficulties in measuring it but outside lab services are available for determination of the porosity of a coating.

1. "A phase diagram for jammed matter". Song, C.; Wang, P. & Makse, H.A. Nature, 29 May 2008

2. "Relationships Between the Microstructure and Properties of Thermally Sprayed Deposits", C. J. Li and A. Ohmori, Journal of Thermal Spray Technology, September 2002
3. "Comprehensive microstructural characterization and predictive property modeling of plasma-sprayed zirconia coatings " A. Kulkarni, et. al., State University of New York at Stony Brook,
4. "Characteristics and electrochemical corrosion behaviour of thermal sprayed aluminium (TSA) coatings prepared by various wire thermal spray processes " S. Shrestha and A. Sturgeon, TWI Ltd

For more information, contact author Dale Moody email DaleRMoody@aol.com.



Free Poster

From Linde and the GTS (Association of Thermal Sprayers) illustrates the different thermal spray processes (suitable for framing).

Send request for poster via email to itsa@thermalspray.org

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Working Metals Expands Its Thermal Spraying

Working Metals Limited, specialist architectural metalwork fabricators, has expanded its thermal spraying services with the purchase of Metallisation equipment.

Working Metals, based in Uckfield, East Sussex, United Kingdom, provides commissioned contract work to individuals and businesses. The company has now added bronze and copper thermal spraying to its services and is amazed with the results. Working Metals' clients are mainly London based architects and are made up of companies that are always looking for new and innovative metal finishes.



Working Metals has always embraced the challenge presented by its creative customer base and has produced



some stunning results using the new Metallisation MK61 flamespray equipment. Amin Taha Architects, one of Working Metals customers, recently specified thermal sprayed bronze to be applied to steel window and door frames and a roof section used in the renovation and conversion of a project in Golden Lane, Islington. The abundant use of bare metal is completely in keeping with its previous design as an industrial piece of architecture. The bronze finish to the steelwork adds a warmth to the building.

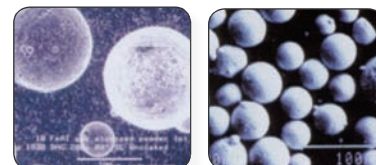
Julian Parker, Owner and Director of Working Metals, says: 'We have been truly amazed by the positive response we

Thermal Spray Powders

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PF25	.06	--	1.5	BAL	1.5	3.5	--	--	--	20-30	1975
PF35	.05	10.5	2.0	BAL	2.0	3.3	--	--	--	32-40	1925
PF40	.30	7.5	1.5	BAL	1.4	4.0	--	--	--	40-48	1925
PF50	.65	14.0	4.2	BAL	2.8	3.8	--	--	--	48-54	1900
PF60	.90	16.5	4.5	BAL	3.3	4.3	--	--	--	56-62	1900
AM58	.90	16.5	4.5	BAL	3.3	4.3	--	--	--	56-62	1900
316L	.03	17.0	BAL	12.0	--	0.8	--	2.5	--	Rb78	2525
80/20	--	20.0	--	80.0	--	--	--	--	--	--	--
PCN38	--	--	0.4	38.0	--	--	61.5	--	--	Rb80	2400
*PHAC	.05	15.5	8.0	BAL	--	0.8	--	16.0	--	--	--
*PI600	.02	14.0	10.0	BAL	--	1.0	--	--	--	Rb74	2600
*PM400	.02	--	--	66.5	--	0.5	32.5	--	--	--	--

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continue to receive from interior designers and architects, with the bronze finishes we have shown them. We are currently working on an expansion program enabling us to handle larger projects, with a dedicated patination team. We are finding that the ability to patinate the sprayed material greatly increases its scope and potential uses."

Working Metals opted for the Metallisation MK61 oxy-acetylene system, which is most commonly used for manual or semi-automatic anticorrosion coatings applied to protect steelwork from corrosion. The system can be supplied as stop/start or continuous spraying, the latter gives a



slightly higher throughput than the former.

In the Metallisation wire flamespray process, the raw material in the form of a single wire or cord, is fed by a driven roller system into the centre of an oxygen-gas flame where it is melted. An annular air

nozzle then applies a jet of high-pressure air, which atomises and projects the molten material towards the work piece. The molten spray solidifies instantly on the component surface to form a dense, strongly adherent coating that has no drying or curing time. The driving of the wire is typically via an air motor and gearbox that forms part of the pistol. The gas fuel used varies, depending on the wire to be sprayed and in some cases, the application. The two most common gas fuels used are propane and acetylene.

Julian continues: "We have worked closely with Metallisation from start to finish and have been very impressed with the company. Their product awareness and knowledge of thermal spraying is second to none. The team also provided training for our staff, which has been invaluable, as it meant we have been able to use the equipment to its maximum capacity from day one."

A video of the thermal spraying of the decorative steel work is available to view on the Metallisation website www.metallisation.com

Established in the UK in 1922, Metallisation is synonymous with thermal spraying to a diverse range of industries around the world. Thermal spraying is a technology, which protects and greatly extends the life of a wide variety of components, structures, equipment and vessels, in the most hostile environments and in situations where protective surface coatings are vital for longevity.

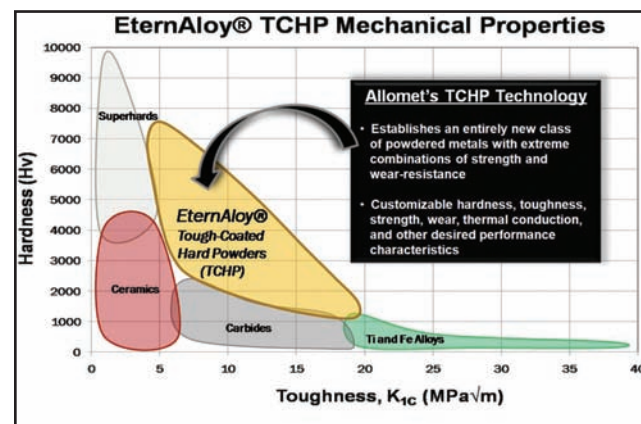
For further information please call Stuart Milton on 01384 252 464 or you can visit www.metallisation.com

Allomet Introduces New Advances in Nano-Engineered Powdered Metal Applications

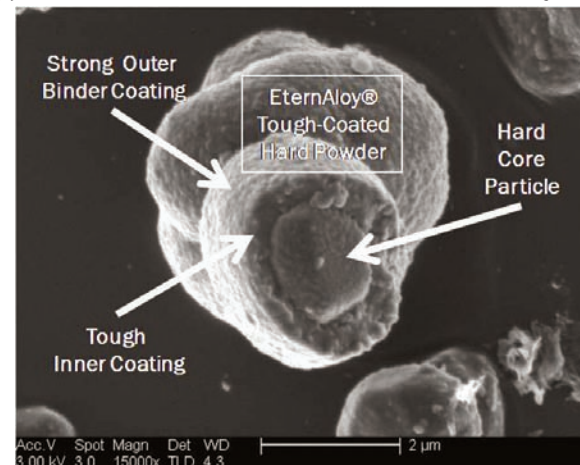


Allomet Corporation, based in North Huntingdon, PA, has firmly established a strong position at the forefront of the nano-engineered powdered metal industry. Using its globally-patented high-technology processes and equipment, the company has successfully developed several grades of unique, high-value commercial materials known as TCHPs (Tough-Coated Hard Powders). Allomet's TCHPs combine very hard (ceramics, diamonds, etc.) and exceptionally tough (tungsten carbide, cobalt, etc.) materials to establish an entirely new class of industrial powders with long sought-after extreme strength and wear-resistance performance characteristics.

Allomet is excited to announce the accelerating expansion of its commercial portfolio which now includes four readily available off-the-shelf product types. These types include two alumina TCHP grades, one titanium carbonitride TCHP grade, and one silicon carbide based tough-coated powder. Developments of additional TCHP products are in progress, including offerings for the high-value industrial "super-hard" category.



Allomet's TCHP powders are proving to be an excellent solution for very intensive wear-resistant surface coating applications in various industries. The extremely high



microhardness, strong adhesion, and low porosity attainable in thermal spray and laser metal deposition coatings provides outstanding performance in very demanding

Continued on page 10.

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Continued from page 8.

environments over a wide range of operating temperatures. With a variety of hard core-particles to choose from, TCHP grades offer customizable hardness, toughness, strength, wear-resistance, thermal conductivity, and lubricity, in addition to other desired performance properties.

Perhaps the strongest feature of the Allomet's new TCHP manufacturing technology is its unsurpassed flexibility. The new TCHP manufacturing technology can meet the precise needs of any critical high-value customer application by combining a variety of materials with property extremes at the nano-scale.

Allomet's TCHP products are in very strong demand in high-value systems applications where productivity, reliability, and safety are critical performance metrics strongly evident in the aerospace, transportation, energy, earthworks, medical, and general industrial markets.

For more information, contact Dave Evans (Vice President of Sales and Marketing) at dave.evans@allomet.net, via phone at 724-864-4787 (Ext. 123), or through the company website at www.allomet.net.



Scholarship Opportunities

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Applications accepted April 15 through June 30 ONLY.

Please visit www.thermalspray.org scholarship area for details and a printable application form.

St. Louis Metallizing has a new Website!

St. Louis Metallizing has completely rebuilt their website from the ground up. Updated videos, certifications, approvals, and capabilities are all included.

The good news is that the URL has not changed. You can still find them at www.stlmetallizing.com.



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Join the International Thermal Spray Association at the Fabtech Thermal Spray Pavilion this year in Las Vegas, NV November 12-14, 2012.



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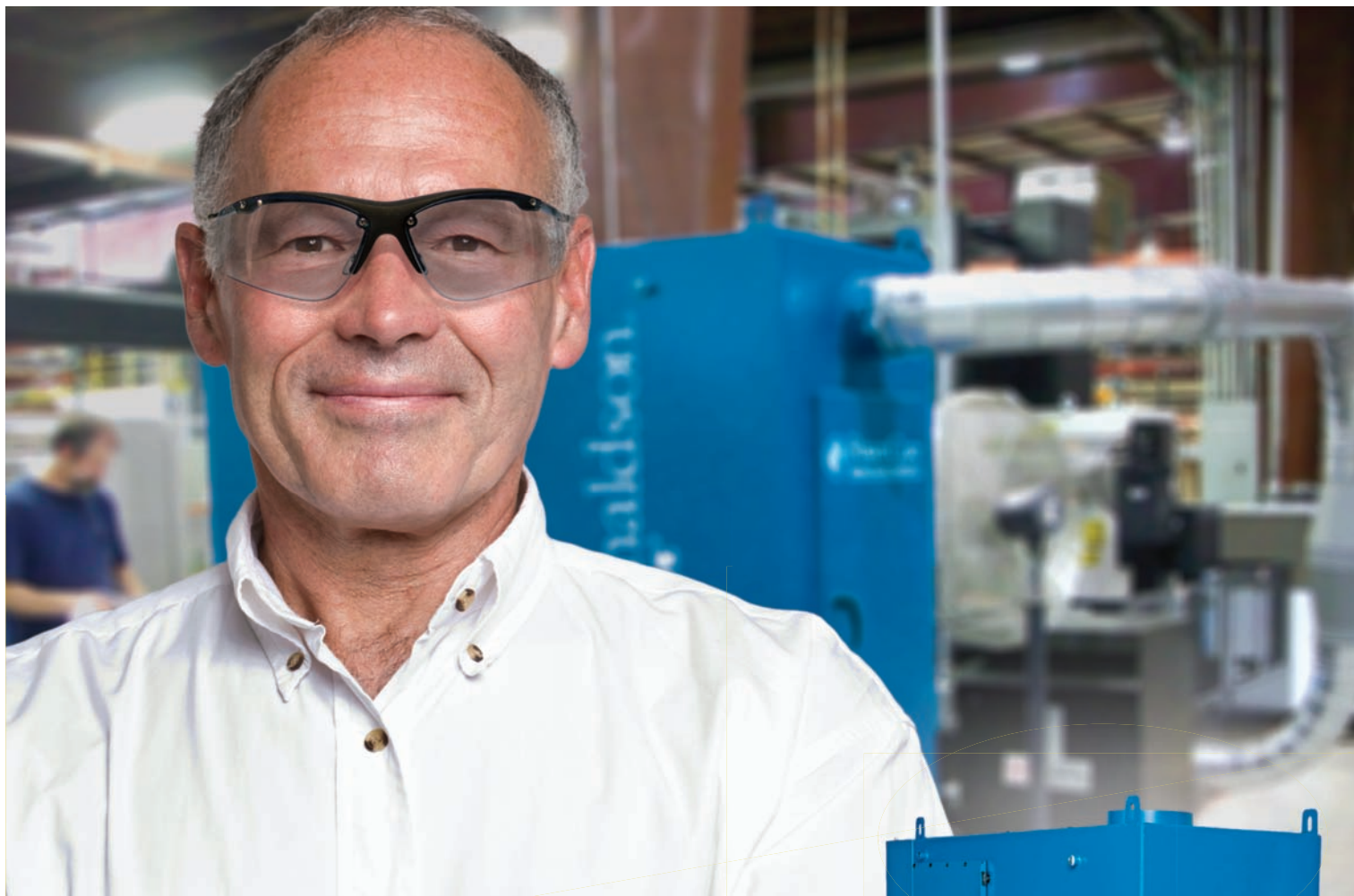
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Bay State Introduces Portable Plasma Spray System



Bay State Surface Technologies is pleased to announce that it has developed the only true portable plasma spray system on the market. This completely self-contained system includes a 30/60 Kw power supply, manual control console, powder feeder, gun, mobile cart, and chiller. All components are mounted on a compact heavy duty steel frame with fold-down ramp, removable rails, fork entry, and electrical disconnects. Optional heavy-duty casters and tank brackets are also available.



With a rated primary input of under 100 amps at 480 volts 3-phase, the portable spray system can be used in multiple booths or for field application of plasma coatings. Ceramics, metallics, and carbides have all been sprayed successfully with the Bay State portable system. Bay State plasma spray equipment provides the lowest operating costs because materials are sprayed with minimal wear to consumables and with low electrical power and gas consumption.

Established in 1960, Bay State Surface Technologies manufactures a full line of affordable plasma spray and twin wire arc spray systems. Bay State is also a value-added supplier of thermal spray powders, wire, and turn-key thermal spray solutions. Bay State is part of the Aimtek family of companies, leaders in brazing and welding technologies. Quality certifications include AS9100, ISO9001, Pratt & Whitney, Rolls Royce, Honeywell, and GE.

For more information, please contact Jay Kapur, General Manager, via email jkapur@aimtek.com or visit www.baystatesurfacetech.com.

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Camfil Farr APC Publishes Spanish Language Dust Collection Capabilities Brochure

A new 24-page Spanish language brochure from Camfil Farr Air Pollution Control (APC) showcases the company's extensive capabilities in the design and manufacture of dust collectors for a wide range of processes. It describes how Camfil Farr APC dust collection



systems solve dust and fume challenges in blasting, chemical processing, custom OEM, fiberglass, food processing, laser and plasma cutting, metal grinding, mining, paper scrap, pharmaceutical, rubber grinding, seed processing, thermal/flame spray, welding and woodworking.

The brochure also includes an overview of the popular "Gold Series®" cartridge dust collectors, which come with a 12-year warranty, and award-winning HemiPleat® filters for new equipment or retrofit use. The company's dust testing and quality assurance programs are featured as well.

Camfil Farr APC is a leading global manufacturer of dust collection equipment and is part of Camfil Farr, the largest air filter manufacturer in the world.

To view or download the brochure online in The Americas, go to: <http://espanol.farrapc.com/about-us>.

For general information in English, visit www.camfilfarrapc.com.

Carpenter Selects Alabama as New Site for New Premium Products Facility

Carpenter Technology Corporation (NYSE: CRS) has selected Limestone County, Alabama as the location to construct its new 400,000 square foot state-of-the-art manufacturing facility that was announced last August. The facility is being built in response to strong customer demand for premium alloy products primarily in the fast-growing aerospace and energy industries. The new facility will ultimately be capable of producing approximately 27,000 tons per year of additional premium product and will be designed with modern technology and optimum product flow to meet customer requirements for reduced lead times.

The approximately 230-acre site is located near Athens, Alabama in the Huntsville Metropolitan Statistical Area. The flat, open tract of land is in an area that will allow relatively easy construction, flexibility for future growth and expansion, and access to a strong pool of skilled workers.

"The site selection process began with about 250 world-wide locations, and we narrowed it down to a dozen, including two Pennsylvania locations," said William A.

Wulfsohn, President and CEO. "After further analyzing state, county and local incentives, utility costs, and labor resources, we felt Limestone County provided the best opportunity for us to expand our core business. The state of Alabama and local government entities put together a very compelling package including various tax initiatives, infrastructure grants, and training programs."

Carpenter's core business will be strengthened with increased premium capacity to support expanded long-term customer agreements. This initiative also enables Carpenter to support the increased demand related to the Latrobe (pending), Amega West, and Oilfield Alloys acquisitions. Finally, this expansion will support increased demand expected from the sales of new technologies which are planned to be commercialized over the coming years.

The facility is expected to be operational in about 30 months, and has a total cost of approximately \$500 million including remelting, forging, and associated finishing and testing capabilities.

The acquisition of the new Alabama site is subject to various closing conditions.

Carpenter Technology produces and distributes conventional and powder metal specialty alloys, including stainless steels, titanium alloys, tool steels and superalloys.

For more information, visit www.cartech.com.

CenterLine Introduces the SST™ Series EP Cold Spray System

CenterLine is very pleased to announce another expansion of its Supersonic Spray Technologies (SST™) product line with the addition of the SST Series EP Cold Spray system.



The Series EP's enhanced features enable users to spray with increased performance and/or productivity using an expanded range of coating materials. This system is ideal for applications requiring higher coating deposition rates, higher deposition efficiency, and greater bond strengths.

With the SST Series EP Cold Spray system, cold spray metal coatings can be applied at operating pressures between 7 to 35 bars (100-500 psi). Material choices include: aluminum and aluminum alloys (AA7075, AA6061, AA4047, etc.), Inconel, Invar, MCrAlY, nickel and nickel alloys, stainless steel (304, 316), and titanium and titanium alloys (Ti6Al4V) to name a few.

The SST Series EP Cold Spray equipment comes complete with portable cabinet, HMI controls, pressurized feeder and robotic style spray gun.

Contact CenterLine today for additional information or visit our SST website at www.supersonicspray.com to learn about our complete cold spray product line and capabilities.

CenterLine's Supersonic Spray Technology Division designs and manufactures a full range of patented cold-spray metal coating systems for the aerospace, defense, glass and automotive industries.

Cold spray is a cost effective and practical coating process that is considered part of the Thermal Spray family. The cold spray process enables users to apply robust metal coatings to a wide range of surfaces without ever melting the coating materials or the substrate. Coating characteristics include extremely low oxide entrapment, high densities and high bond / cohesive strengths. They are also extremely machine-able (with conventional tooling), have thin or thick build characteristics and are accepting of dissimilar materials with no galvanic reactions

For more Information, contact Ed Malison – Director of Business Development phone: (519)835 6422 email: ed.malison@cntrline.com



ArcMelt Adding Distribution

ArcMelt is now actively adding Supply Houses and Distributors to carry their line of composite alloy wires for thermal spray and weld overlay applications.

For more information or to become a distributor, contact Mark Hubbs, email mahubbs@arc melt.com, phone (314) 801-6932 or visit website www.arc melt.com

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Thermal Spray Development Program for Marine Structures With Focus on Wind Turbines and Cruise Ships

The International Zinc Association (IZA) has initiated a "Thermal Spray Program for Marine Structures". A first meeting was held in Brussels on February 7, 2012 with representatives from industry including Grillo Werke, Umicore, Sulzer Metco, Linde, GTS and the Aachen University.

The goal of the thermal spraying development project is to improve the corrosion protection of steel used in off-shore wind turbines as a first priority and also in the cruise ship industry. Under the umbrella of IZA, a common platform will be created including an internet-based knowledge data base which will



provide technical information, case studies and technical assistance on corrosion protection in these markets. Furthermore, technical brochures will be developed to raise awareness of

the benefits of zinc spraying. Seminars and presentations to potential users at conferences, as well as in-house seminars for those responsible for corrosion protection in these markets, will be a key part of the program. Wind turbine structures and cruise ships have challenging requirements for providing satisfactory corrosion protection. The wind turbine industry strives for building and operating wind turbines with a twenty-five year or longer, ideally maintenance-free, service life. It is expected that both the zinc thermal spraying and paint industries together would be able to supply corrosion protection systems reaching these expected standards of the target industries.

IZA wishes to thank Mr. Krömmer from Linde, Chairman of GTS, who helps facilitate this project.

A market development plan is currently being developed which will be reviewed by the project group at the Linde location in Unterschleissheim, Germany, on May 14th, 2012. The project group welcomes interested companies from every sector of the thermal spray market, including:

- Companies supplying zinc consumables such as wire and powders
- Machinery makers which supply spraying equipment such as flame or electric arc sprayers or similar equipment
- Companies specialized in preparing steel surfaces
- Companies which can apply the coatings to the steel (both in their plant and at the location of the customer)
- Paint companies that rely on the sprayed zinc surface as a substrate

- University representatives who can conduct testing
- Engineering companies that make the specifications

For more information and to participate in the upcoming meeting, please contact Frank Goodwin, Director Technology and Market Development, International Zinc Association, email fgoodwin@zinc.org, phone: +1 919 287 18 78

The International Zinc Association (IZA) was founded in 1991 and is a global non-profit organization. IZA is dedicated exclusively to the interests of zinc and its users and helps sustain the long-term global demand for zinc and its markets by promoting key end uses as corrosion protection for steel, die casting, brass, oxide and sheet; and the essentiality of zinc in human health and crop nutrition. IZA's main programs are Sustainability and Environment, Technology and Market Development and Communications.

For further information, visit <http://www.zinc.org>.

Kennametal Completes Acquisition of Deloro Stellite

Kennametal Inc. (NYSE: KMT) announced that it has completed the acquisition of Deloro Stellite Group from private equity firm Duke Street.

Deloro Stellite is a global manufacturer and provider of alloy-based critical wear solutions for extreme environments involving high temperature, corrosion and abrasion. The company's proprietary metal alloys, materials expertise, engineering design and fabrication capabilities complement Kennametal's current business in the oil/gas, power generation, transportation and aerospace markets.

Kennametal conducts acquisitions according to a disciplined process that is part of the company's management operating system known as the Kennametal Value Business System (KVBS). This acquisition supports Kennametal's growth and investment strategies and positions the company to further achieve geographic and end market balance.

Kennametal Inc. (NYSE: KMT) delivers productivity to customers seeking peak performance in demanding environments by providing innovative custom and standard wear-resistant solutions. This proven productivity is enabled through our advanced materials sciences and application knowledge. Our commitment to a sustainable environment provides additional value to our customers. Companies operating in everything from airframes to coal mining, from engines to oil wells and from turbochargers to construction recognize Kennametal for extraordinary contributions to their value chains. In fiscal year 2011, customers bought approximately \$2.4 billion of Kennametal products and services – delivered by approximately 12,000 talented employees doing business in more than 60 countries – with more than 50 percent of these revenues coming from outside North America.

Visit www.kennametal.com and www.stellite.com.

New Thermal Spray Booths for Liburdi's Gas Turbine Repair Facility



Liburdi Turbine Services, Inc. recently acquired two new spray booths at their head office and gas turbine repair facility in Dundas, Ontario, Canada. One booth contains a Sulzer Metco High Velocity Oxygen Fuel System (HVOF) while the second booth contains a Sulzer Metco Plasma Spray System. Both spray systems mount to a Fanuc Six Axis Robot which is fully integrated with rotary-tilt turntables for a total of 8 axis of articulation. The primary applications consist of airfoil coatings for gas turbine component repairs and upgrades.



Each unique component type requires its own specific spray program to ensure full coverage and uniform thickness. Using an advanced, off-line programming package, the controller has the ability to take computer generated models and translate the coordinate system directly, thus improving the coating uniformity and quality on complex geometries. Liburdi's in-house tooling design, machining and full metallographic capabilities aid in rapid

coating development and robust quality assurance.

Liburdi Turbine Services, Inc provides a complete range of component refurbishment as well as advanced life extending processes for the latest class of high performance aero and industrial turbines including - FSR® Full Solution Rejuvenation® Powder Metallurgy, automated welding processes, and unique coatings for erosion, oxidation and corrosion resistance.

For further information about Liburdi, send an email to rtollett@liburdi.com or visit www.liburdi.com



4th Thermal Spray Conference at Fabtech Tuesday, November 13

Mark your calendar now for travel to Las Vegas for the fourth annual one-day Thermal Spray Conference.

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Ellison Surface Technologies Opening New Facility in Canada

Ellison Surface Technologies, Inc (EST) is currently undergoing construction on a thermal spray coating and special process facility in Bromont, Quebec, Canada.



Establishment of the EST-Bromont facility comes as a result of a long-term partnership in the United States between Ellison Surface Technologies and GE-Aviation. The two companies have entered into a multi-year master subcontracting agreement in which Ellison will provide GE-Aviation Canada with thermal spray coating and supporting services for some of its most prominent aircraft engine programs. The Ellison facility in Bromont is expected to be in production in late 2012 and will initially have 30-40 employees.

The agreement was made official during a signing ceremony and press conference on January 19 in Bromont.

Members of the Parliament of Quebec, the city of Bromont, numerous aerospace companies, agencies and organizations were all in attendance to witness the signing between Tim Perkins, Vice President of Ellison Surface Technologies, and Philippe Simonato, Plant Manager of GE-Aviation's operation in Bromont. After a record 2011, in which Ellison celebrated its 25th anniversary, the new partnership with GE-Aviation Canada is another growth milestone for the company.

Expansion into Canada provides Ellison with a stronger presence in the international thermal spray community, particularly in Quebec which is home to one of the world's largest aerospace manufacturing and development clusters.

"Our Canadian expansion is a significant part of Ellison's long-term strategic initiatives," says C. Michael Ellison, President and CEO of Ellison Surface Technologies. "We are excited to reach this agreement with GE-Aviation and to become their coating and special process partner in Canada."

For more information, visit www.ellisonsurfacetech.com

4th Thermal Spray Conference at Fabtech Tuesday, November 13

Mark your calendar now for travel to Las Vegas for the fourth annual one-day Thermal Spray Conference.

Dry Ice Stripping – A New Cost-Saving Coating Removal Method



for Top Coat of Thermal Barrier Coatings.

Thermal barrier coatings (TBC) have got considerable importance for the improvement of gas turbine efficiency. These materials are applied on the surface of gas turbine blades and vanes. Coating removal is an important aspect in the production of these blades and vanes. "Decoating" or "stripping" is needed during the production of new components as well as for the reconditioning of existing ones.

The main characteristic of the stripping processes is the removal of the coating without damaging the base material of the component (avoiding corrosion, geometrical variations, etc.). At the state of the art the removing of the TBC system is very time consuming and expensive: It is necessary to remove the ceramic top coat (TC) by sand blasting and the metallic MCrAlY bond coat (BC) by chemical acid attack.

The TC and/or BC stripping is also necessary on new coated parts during MCrAlY or TBC manufacturing to correct problems of coating quality (thickness, porosity, roughness, adhesion, etc.) and during repair operations on serviced coated components.

This leads to have very high rework and environmental costs.

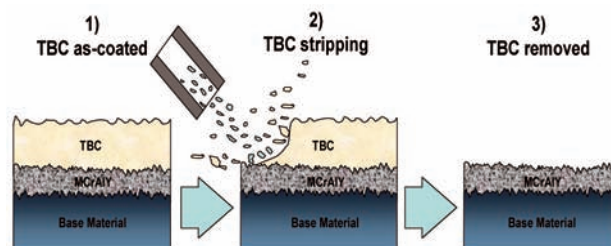
ARTEC/TURBOCOATING in cooperation with A&G developed a new removal method and equipment for the ceramic top coat only.

This method has no impact on the roughness and morphology of the bond coat surface, making it suitable for re-coating with ceramic top coat, without any further operation before recoating.

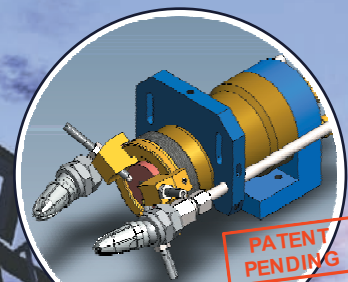
The new method has an important impact on the stripping costs and time, avoiding all the operations related to the bond coat as shown below.

Regular Stripping Dry Ice Stripping

Masking	⋮
Stripping	Dry Ice Stripping
Sand Blasting	⋮
LPPS (BC) coating	⋮
Heat Treatment	⋮
APS (TC) coating	APS (TC) coating



Dry Ice stripping (DIS) enables the removal of ceramic TC without modifying the MCrAlY bond coat characteristics and (mainly) the surface morphology. **Continued on page 18.**



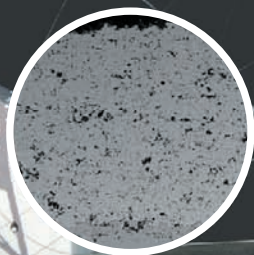
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COATING SOLUTIONS

Continued from page 16.

The dry ice blasting process acts upon the TBC system by a combination of mechanical and thermal mechanisms: the kinetic energy of the blast medium, on account of shock waves on the interface between protective coating and substrate creates cracks and removes particles of the protective coating which are already blasted off, or which have only poor adhesion to the coating.

Since dry ice, comparable with gypsum, is rather soft, there is practically no abrasive effect. Consequently, the TBC coating can be removed without damaging the metallic coating which lies beneath, even if this consists of mild steel or stainless steel, nickel alloys or even aluminium alloys.

The validation of this method on real components in cooperation with a major OEM shows that the new method removes the ceramic TBC system without damaging MCrAlY surface characteristics. The dry ice stripping process is able to remove the TBC coatings without damaging the main characteristics of the MCrAlY bond coat as thickness, roughness and surface morphology. It is possible to re-use the bond coat of real components with TBC obtaining high adhesion and cycling oxidation resistance. This has been proved by metallographic analysis and functional tests such as Thermal Cycling Fatigue test, according to the specification of a main OEM. Moreover, blades treated by Dry Ice Stripping and following recoated are currently in operation in the engines, guaranteeing very good results.

In conclusion it is interesting to mention that dry ice stripping has several advantages respect to the traditional stripping, when it is important to remove only the TBC. We could mention the following:

1. Technological advantage: It is possible to save and avoid one (1) bath in the acid (chemical stripping) of the components as in lifetime, usually the OEMs specification limit the possibility of chemical stripping to three (3) times. When a component show defect to the TBC but not to the bond coat, it can be treated by means of Dry Ice Stripping, saving one of this time making it repairable one time more and in any case not allowing any kind of intergranular attack from the acid.
2. Logistic advantage: The component which is damaged on the TBC (e.g. chipping, local delamination, etc), usually is submitted to NCR, quarantined and submitted to acid stripping with make necessary the repetition of the entire coating cycle, from bond coat to finishing. Therefore the component usually is segregated by the set and run its own road, with management costs in order to follow it separately. With Dry Ice stripping the component could be immediately submitted to the removal of the TBC, while the lot is still under coating and put again in the queue of the lot, which consequently remain completed.
3. Economical advantage: It is quite intuitive to appreciate the advantages in the stripping cycle, in case of application of the common chemical stripping and of dry ice stripping procedure.

Last but not least, this method is environmental friendly in comparison with the state of the art stripping process.

For more information please visit our homepage www.turbocoating.com or send an email to research@turbocoating.it.

FABTECH 2011 Breaks Records

The 2011 Fabtech event culminated with a total of 1,360 exhibiting companies covering an astounding 523,740 net square feet of floor space. Over 35,000 attendees made this the largest FABTECH to date!

29% of exhibitors reported FABTECH exceeded their lead generation expectations.

When buyers think about new technology, FABTECH is the place they come to see the latest and greatest available to the world.

Audience Facts:

- 52% were first time attendees and 61% attend no other show
- 29% had job titles of corporate executive/top-level management or job shop owner
- 11% of attendees came from outside the U.S.
- 82% of visitors are involved in some way in their company's purchasing plans
- 44% indicated budgets of \$200,000 or more to spend on products and services
- 52% of attendees plan to make a purchase in the next 6-9 months.

4th Thermal Spray Conference at Fabtech Tuesday, November 13

Mark your calendar now for travel to Las Vegas for the fourth annual one-day Thermal Spray Conference.



Thermal Spray Pavilion

Join the International Thermal Spray Association at the Fabtech Thermal Spray Pavilion this year in Las Vegas, NV November 12-14, 2012.



To reserve your booth space, contact Joe Krall, Exposition Sales, 800.443.9353, jkrall@aws.org

EWF Training Course European Thermal Spraying Specialist (ETSS)

The GSI-SLV would like to draw your attention to the EWF Training Course of the European Thermal Spraying Specialist (ETSS), which will be run according to EWF guideline 459 for the first time in English language in 2012.

Having passed the exams, a lifetime valid diploma is awarded at the end of the course.

International acknowledged diplomas gain more and more importance, because many international standards require a certified qualification of thermal spraying personnel. With altogether 140 lesson units, the EWF-guideline 459 offers a very comprehensive education of spraying personnel to take over a wide range of responsible tasks.

Suggest participants are supervising/coordinating personnel, foremen and executives in the field of thermal spraying

Contents: High-quality and economic thermal spraying requires a special technical knowledge. Thermally sprayed layers are applied in many fields. The requirements to the quality of the sprayed layers are often very high. The necessary quality of the layer is only efficient if planning, execution and controlling of a thermally sprayed layer is performed by a skilled expert from the first draft until the last job. Within the scope of the common professional education the manifold details to be observed for expert spraying cannot be taught to the required extent. A

supplementary education is required which has been created by the EWF – European Federation for Welding, Joining and Cutting – with the course of the European Thermal Specialist.

This course will be performed according to the training guideline DVS-EWF 1188 and is concluded by exams according to guideline DVS – EWF 1189.

There are required qualifications which can be obtained by contacting the GSI-SLV.

For more information, visit <http://www.gsi-slv.de>, phone +49 203 3781-132, email sekretariat@gsi-slv.de



Scholarship Opportunities

Since 1991, the **International Thermal Spray Scholarship Program** has contributed to the growth of the thermal spray community. ITSA offers up to three Graduate Scholarships **worth \$2,000.00 each**.

Applications accepted April 15 through June 30 ONLY.

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ITSA Mission Statement

The International Thermal Spray Association 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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Mr. Bob Unger, runger@polymet.us

Praxair Surface Technologies - Concord, NH USA
www.praxair.com/thermalspray 603.224.9585
Mr. Richard Thorpe, richard_thorpe@praxair.com

Progressive Surface - Grand Rapids, MI USA
www.ptihome.com 800.968.0871
Mr. Bill Barker, wnb@ptihome.com

Saint-Gobain Ceramic Materials - Worcester, MA USA
www.coatingsolutions.saint-gobain.com 508.795.2351
Mr. Howard Wallar, howard.wallar@saint-gobain.com

Sulzer Metco (US) Inc. - Westbury, NY USA
www.sulzermetco.com 516.334.1300
Ms. Mae Wang, mae.wang@sulzer.com

Thermach, Inc. - Appleton, WI USA
www.thermach.com 920.779.4299
Mr. David Lewisen, davelewis@thermach.com

Thermion, Inc. - Silverdale, WA USA
www.thermioninc.com 360.692.6469
Mr. Dean Hooks, dean@thermioninc.com

ASSOCIATE MEMBER ORGANIZATIONS

Advanced Materials and Technology Services, Inc.
Simi Valley, CA USA

www.adv-mts.com - 805.433.5251
Dr. Robert Gansert, rgansert@adv-mtv.com

ASM Thermal Spray Society - Materials Park, OH USA
http://tss.asminternational.org 440.338.5151
Randall S. Barnes, randall.barnes@asminternational.org

State University of New York at Stony Brook
Stony Brook, NY USA
www.ctsr-sunysb.org 631.632.8480
Prof. Sanjay Sampath, ssampath@ms.cc.sunysb.edu

SUPPORTING MEMBER SOCIETIES

AWS, The American Welding Society
www.aws.org 305.443.9353
Mr. Jeff Weber, jweber@aws.org

DVS, The German Welding Society
www.die-verbindungs-spezialisten.de
Mr. Jens Jerzembeck, jens.jerzembeck@dvs-hg.de

GTS e.V., The Association of Thermal Sprayers
www.gts-ev.de +49.89.31001.5203
Mr. Werner Kroemmer, werner.kroemmer@gts-ev.de

IMM, Institute of Materials Malaysia
www.iomm.org.my 603.5882.3584
Mr. Johar Juhari, johar_juhari@petronas.com.my

JTSS, Japan Thermal Spray Society
+81.6.6722.0096
Mr. Nick Yumiba, jtss@mb8.seikyoku.ne.jp

MPIF, Metal Powder Industries Federation
www.mpif.org 609.452.7700
Mr. James R. Dale, jdale@mpif.org

TSCC - Thermal Spraying Committee of China Surface Engineering Association
www.chinathermalspray.org +86.10.64882554
Prof. Huang Xiaoou, Xiaou@chinathermalspray.org

Visit us at www.thermalspray.org



The **International Thermal Spray Association** is closely interwoven with the history of thermal spray development in this hemisphere. Founded in 1948, and once known as Metallizing Service Contractors, the association has been



Chairman Wright

closely tied to most major advances in thermal spray technology, equipment and materials, industry events, education, standards and market development.

A company-member association, ITSA invites all interested companies to talk with our officers, and company representatives to better understand member benefits. A complete list of

ITSA member companies and their representatives can be found at www.thermalspray.org

ITSA Mission Statement

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

Officers

Chairman: **David Wright**, Accuwright Industries, Inc.
 Vice-Chairman: **Jason Falzon**, FW Gartner Thermal Spraying
 Treasurer: **Bill Mosier**, Polymet Corporation
 Corporate Secretary: **Kathy Dusa**
Executive Committee (above officers plus the following)
Dan Hayden, Hayden Corporation
John Read, Cadorath Plating Ltd.
Joseph Stricker, St. Louis Metallizing Company

ITSA Scholarship Opportunities

The International Thermal Spray Association 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 www.thermalspray.org for criteria information and a printable application form.

ITSA Thermal Spray Historical Collection

In April 2000, the International Thermal Spray Association announced the establishment of a Thermal Spray Historical Collection which is now on display at their headquarters office in Fairport Harbor, OH and the State University of New York at Stony Brook in the Thermal Spray Research Center, USA.

Growing in size and value, there are now over 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 worldwide industry collection and we welcome donations from the entire thermal spray community.

ITSA SPRAYTIME Newsletter

Since 1992, the International Thermal Spray Association has been publishing the **SPRAYTIME** newsletter for the thermal spray industry. The mission is to be the flagship thermal spray industry newsletter providing company, event, people, product, research, and membership news of interest to industrial leaders, engineers, researchers, scholars, policy-makers, and the public thermal spray community.

ITSA Headquarters

Post Office Box 1638, Painesville, OH 44077 USA
 voice: 440.357.5400 • fax: 440.357.5430
itsa@thermalspray.org • www.thermalspray.org

Become a Member of The International Thermal Spray Association

Your company should join the International Thermal Spray Association (ITSA) now! As a company-member, professional industrial association, our mission is dedicated to expanding the use of thermal spray technologies for the benefit of industry and society.

ITSA members invite and welcome your company to join us in this endeavor.

New - All ITSA company members are now also Supporting Members of the American Welding Society.

Whether you are a job shop, a captive in-house facility, an equipment or materials supplier, an educational campus, or a surface engineering consultant, ITSA membership will be of value to your organization.

The most valuable member asset is our annual membership meetings where the networking is priceless! Our meetings provide a mutually rewarding experience for all attendees - both business and personal. Our one-day technical program and half-day business meeting balanced by social activities provide numerous opportunities to discuss the needs and practices of thermal spray equipment and processes with one another.

As an ITSA member, your company has excellent marketing exposure by being listed on our website along with a multitude of additional benefits.

ITSA member companies are also highlighted in the ITSA booth at several trade shows throughout the year (International Thermal Spray Conference ITSC, Fabtech Thermal Spray Pavilion and Conference, Weldmex Mexico, PowerGen, Society of Vacuum Coaters and TurboExpo).

If you would like to discuss the benefits of your company becoming a member of the International Thermal Spray Association, we suggest you contact Kathy Dusa at ITSA headquarters office, phone 440.357.5400 or visit the membership section at www.thermalspray.org.

NEW "Supporting Societies" Membership

The International Thermal Spray Association is pleased to announce a new "Supporting Societies" membership category to establish communication with other associations/societies involved in thermal spray and surface engineering activities worldwide.

See the Supporting Societies listing on page 21.

This is ideal for membership exchange between organizations. Contact Kathy Dusa at the headquarters office via email to itsa@thermalspray.org



Scholarship Opportunities

Since 1991, the *International Thermal Spray Scholarship Program* has contributed to the growth of the thermal spray community. ITSA offers up to three Graduate Scholarships **worth \$2,000.00 each**.

Applications accepted April 15 through June 30 ONLY.

Please visit www.thermalspray.org scholarship area for details and a printable application form.

ITSA On Facebook

Dear Thermal Spray Colleague,

The International Thermal Spray Association now has a very basic Facebook Page. If you are a Facebook user, you can simply type in thermal spray in the top search engine. At that point, select "like" and you will be connected to the ITSA page. Right now, we have our ITSA promotion video on the page, plus a few recent messages. We are not sure how and to what extent this will be used, but it was apparent by some recent and continuing requests that we be there. If you are a Facebook visitor, enjoy.

Thermal Spray Jobs listed at "For Hire" www.thermalspray.org

4th Thermal Spray Conference at Fabtech Tuesday, November 13

Mark your calendar now for travel to Las Vegas for the fourth annual one-day Thermal Spray Conference.

International Thermal Spray Association Welcomes New Member

Hausner Hard-Chrome has joined the International Thermal Spray Association.

Hausner Hard-Chrome (HHC) roots began in Germany, where Hans Hausner developed and operated one of the largest Hard Chrome Plating plants from the 1930's to the end of World War II. After the war, he immigrated to the United States with his family, where he and his son Wolfgang started the business again with a small plant in Chicago. Upon Hans' retirement and the closure of the plant, Wolfgang founded Hausner Hard-Chrome in Elk Grove Village, Illinois in the late 1960's. The operation has since grown into one of the largest hard chrome plating facilities in the United States with its main administration location in Owensboro, KY. Currently HHC operates two locations and employs over 100 personnel. Wolfgang's two sons, David and Jeff, are third generation owners and now run the business.

HHC purchased Hausner Industrial Coatings (Metallizing Inc.) in 2005 which is located in Elk Grove Village, IL and have performed brush plating services for the 20 plus years. Today, HHC provides full spectrum in-plant hard coating services that include hard chrome, thermal spray coatings, brush plating and associated machining, polishing, grinding, and welding. A new Hausner Hard Chrome business unit, HHC On-Site Services, was established in 2010. This new on-site service has expanded thermal spray, brush plating, welding machining, grinding and polishing services.

HHC is committed to providing a full-spectrum-best-value hard coating application for customer needs. Thermal spray coatings offerings are expanding as an alternative applications for wear, corrosion and repair. HHC is fully committed to addressing changing Industry issues and needs throughout the world.

For more information, contact ITSA company representative Bruce Dulin, bruce.dulin@hausnerinc.com and visit their website www.hausnerinc.com.



Thermal Spray Pavilion

Join the International Thermal Spray Association at the Fabtech Thermal Spray Pavilion this year in Las Vegas, NV November 12-14, 2012.



To reserve your booth space, contact Joe Krall, Exposition Sales, 800.443.9353, jkrall@aws.org



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**Polymet Corporation
Celebrates
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Polymet is excited to celebrate 45 years of offering welding and coating solutions for the world's demanding applications.

What started as a small aerospace consulting firm has grown into a world recognized leader in the production of hardfacing alloys, welding and thermal spray materials. From the roots of a few engineers producing nothing more than ideas for new and improved materials; Polymet has developed into a manufacturing firm that brings these materials to life.

The materials that Polymet produces are engineered for some of the most demanding applications in the world. From iron based amorphous alloys to nickel based alloys for the aerospace industry, Polymet manufactures the highest quality wire in the world for both twin wire arc spray and flame spray operations. Polymet's unique hot extrusion technology allows it to produce cobalt-based hardfacing alloys for GTAW, hot wire TIG, plasma and laser welding. Polymet also offers aerospace grade welding wire whose cleanliness and level of quality have caused customers around the world to demand Polymet processing in their specifications.

Whether for gas turbine engines, high pressure valves or

nuclear reactors, Polymet engineers all of its products to the highest standard of quality to ensure integrity in each piece of wire.

"Throughout these 45 years, there is one fact that remains the foundation of our belief system at Polymet. Without our dedicated employees, loyal customers, dependable suppliers and strategic partners throughout the world, there would be no Polymet. The relationships and friendships that have been forged throughout the history of Polymet are what keep us energized to do what we do" says Bill Mosier, president of the company.

Today, Polymet continues to specialize in innovative solutions for demanding hardfacing, welding, and thermal spray applications.

About Polymet: Polymet (www.polymet.us), a world-class manufacturer of high performance wire for hardfacing, welding and thermal spraying, produces high quality products used in the aerospace, automotive, cement, mining, lumber, nuclear, power generation and many other industries. Our wires are ideal for demanding applications such as metal to metal, metal to earth, high impact, high abrasion, corrosion and high temperature, or combinations of these wear factors.

For more information, please contact Danny Newman, dnewman@polymet.us or visit www.polymet.us

See advertisement page 3.



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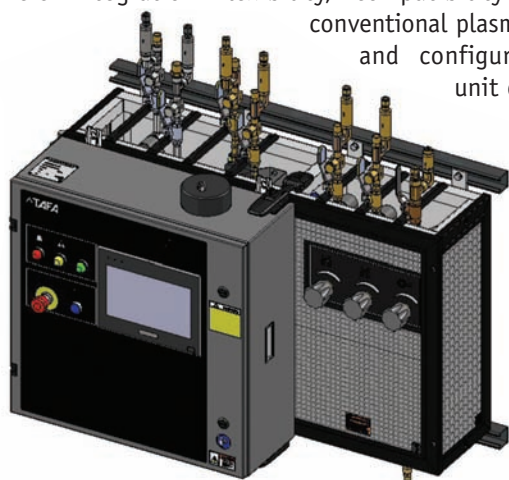
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1000 degrees C
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Plasma Giken has developed new, no-clog cold spray technology for varied applications in chemical, aerospace, semi-conductor, energy, and medical industries. The Cold Spray PCS-1000 advancements make possible the application of even difficult metals such as Ni, Ti, Ti6Al4V, Inconel alloys, and stainless steel at thicknesses of more than 10mm, while maintaining nearly 100% deposition efficiency for maximum reliability and performance. **Don't believe it? Contact us for some samples, or visit our Open Laboratory and test it for yourself.**

Praxair Surface Technologies Introduces Plasma Controller Featuring Proven, Accurate Flow Control that Reduces Costs

Praxair Surface Technologies Inc., a wholly-owned subsidiary of Praxair Inc. (NYSE: PX), introduces the innovative TAFE model 6600c plasma control console. The TAFE 6600c offers integration flexibility, compatibility with all conventional plasma torches, and configurable flow unit displays.

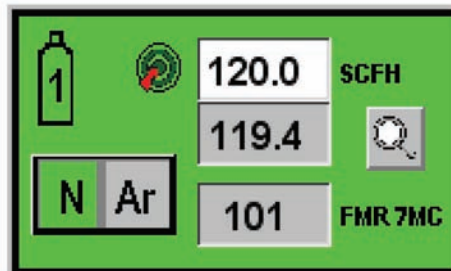


Model 6600c Plasma Control Console.

Based on more than 45 years of proven and accurate critical-orifice gas flow control, the TAFE 6600c advances ease-of-use to the next level by converting pressure readings to digital flow readouts.

Operational Flexibility and Operator Transition Made Easy:

Dual gas flow readout displays on the TAFE 6600c control screen provide easy transition for operators with experience using other plasma controllers and processes. For example, users can configure the Operator Interface Terminal (OIT) display to transition operator knowledge on



Flexible Dual Gas Flow Display.

the TAFE model 3710 to the TAFE 6600c with a 3710 emulation control screen or choose another screen and configure dual flow read backs for each

gas to display units in two different measurement values.

Reduces Booth Requalification Expenses:

Using two different display values solves a vexing problem that bridges readings between conventional and nonconforming measurement systems so customers can still use or display established (OEM specification approved) spray parameters with new controls. For example, users can reduce or eliminate potential spray booth requalification expenses when using the TAFE 6600c. Configure one read back with the imperial, metric, or nonconforming FMR measurement system and then the second readout with a different measurement system.

Reduce Operating Costs

To significantly extend electrode use, the TAFE 6600c has a "soft-start" capability to automatically change primary gas flow from argon to nitrogen after ignition, if desired. This soft-start capability increases anode life by minimizing anode gouging due to high-start currents and concentrated arc footprints.

Praxair Surface Technologies offers a comprehensive slate of high-performance coatings and technologies to the aviation, energy, and other industries. By continuously advancing coatings technologies, Praxair Surface Technologies helps customers improve environmental performance, decrease energy consumption, extend component life, improve productivity, minimize downtime, reduce operating costs, and produce higher quality products.

For more information, visit websites www.praxairsurfacetechologies.com and www.praxair.com.

See Advertisement page 19.

STICK WITH THE BEST DeWAL Thermal Spray Tapes



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For wire arc and HVOF, DeWAL double-ply tapes reduce set-up time and withstand the harshest environments. DeWAL tapes can be single-ply or multi-layer.

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LinkedIn Has Thermal Spray Group

The business social network "LinkedIn" has a group titled "Thermal Spray Coating" **currently with 431 members** and some discussions.

If you are interested, please visit www.linkedin.com and join the network and then join the group.

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spraytime@thermalspray.org**

CALENDAR OF EVENTS 2012

19-20 Galveston, TX USA *International Thermal Spray Association Annual Membership Meeting* - email itsa@thermalspray.org



International Thermal Spray Conference 2012 Houston, Texas, USA May 21-24, 2012

**Air, Land, Water and the Human Body:
Thermal Spray Science and Applications**
For more information,
visit www.asminternational.org/itsc

23-26 St. Petersburg, Russia *Essen Welding Pavilion* -
visit www.schweissen-schneiden.com

JUNE 2012

10-13 Nashville, TN USA *PowderMet 2012 Int'l Conference on Powder Metallurgy* - visit www.mpif.org



11-15 Copenhagen Denmark *ASME TurboExpo 2012* -
www.turboexpo.org



11 JUN - 4 JUL Munich, Germany *European Thermal Spraying Specialist (ETSS) Course* - email slv@slv-muenchen.de, visit www.slv-muenchen.de

12-14 San Diego, CA USA *Mega Rust 2012: U.S. Navy Corrosion Conference* - Teresa Denchfield tdenchfield@navalengineers.org

18-21 Charlotte, NC USA *AeroMat 2012* - visit www.asminternational.org

24-29 Bologna, Italy *12th European Plasma Conference HTPP-12* - visit www.htpp12.com

JULY 2012

8-14 Denver, CO USA *65th Annual Assembly IIW International Conference* - Contact-IIW General Secretariat, email l.durand@iiwelding.org

10-11 Lumpur, Malaysia *8th Int'l Materials Conference and Exhibition IMTCE 2012* - visit www.imtce2012.com

22-28 Beijing, China *ICCE-20 20th Annual Int'l Conference on Composites or Nano Engineering* - visit www.icce-nano.org

SEPTEMBER 2012

24-27 Houston, TX USA *41st Turbomachinery Users Symposium and 27th Pump Users Symposium* - visit <http://turbolab.tamu.edu>

OCTOBER 2012

7-11 Pittsburgh, PA USA *MS&T'12 Materials Science & Technology Conference and Exhibition* - visit www.matscitech.org

9-12 Vienna, Austria *Vienna-Tec - International Fair for Industry and Trade* - visit www.vienna-tec.at

23-27 Hanover, Germany *EuroBLECH 2012 22nd Int'l Sheet Metal Working Technology* - visit www.euroblech.com

29-31 India *Essen Welding Cutting Surfacing with Metallurgy India and Tube India* - www.schweissen-schneiden.com

NOVEMBER 2012

8-9 Erding, Germany *9th HVOF High Velocity Oxy-Fuel Flame Spraying Colloquium 2012* - email hvof@gts-ev.de, web hvof.gts-ev.de



11-15 Phoenix, AZ USA *ISTFA 2012 38th Int'l Symposium for Testing and Failure Analysis* - visit www.istfa.org

12-14 Las Vegas, NV USA *FABTECH with a Thermal Spray Pavilion and Conference* - visit www.fabtechexpo.com



4th Thermal Spray Conference at Fabtech Tuesday, November 13

Mark your calendar now for travel to Las Vegas for the fourth annual one-day Thermal Spray Conference.



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DECEMBER 2012

12-13 Orlando, FL USA *Power-Gen Conference and Exposition* - visit www.power-gen.com

2013

MARCH 2013

17-21 Orlando, FL USA *Corrosion 2013* - visit www.nace.org

MAY 2013

TBD Salt Lake City, UT USA *Int'l Thermal Spray Association Annual Membership Meeting and Technical Program* - contact itsa@thermalspray.org



SEPTEMBER 2013

16-21 Essen, Germany *Int'l Trade Fair Joining Cutting Surfacing* - visit www.schweissen-schneiden.com

NOVEMBER 2013

TBD Chicago, IL USA *FABTECH with a Thermal Spray Pavilion and Conference* - visit www.fabtechexpo.com



2014

MARCH 2014

9-13 San Antonio, TX USA *Corrosion 2014* - visit www.nace.org



Thermal Spray Pavilion

Join the International Thermal Spray Association at the Fabtech Thermal Spray Pavilion this year in Las Vegas, NV November 12-14, 2012.



To reserve your booth space, contact Joe Krall, Exposition Sales, 800.443.9353, jkrall@aws.org

Finishing Online Website Now Includes Thermal Spray

The website "Finishing Online" (www.finishingonline.com) now includes "thermal spray" in an "industries" area. Everyone is eligible for a basic free listing for one year. Go to their website to register and get your free listing.

Journal of Thermal Spray Technology®

A publication of the *ASM Thermal Spray Society*
Plasma Jet-Substrate Interaction in Low Pressure Plasma Spray-CVD Processes

PH. Guittienne, D. Grange, Ch. Hollenstein, and M. Gindrat

Conventional equipment for plasma spraying can be adapted for operation at low pressure so that PECVD-like processing can be preformed. The plasma jet generated by the torch is characterized by a high convective velocity and a high gas temperature. The influence of these properties on a deposition process are investigated in the framework of simple theoretical considerations and illustrated by various experimental results obtained with SiO_x deposition. A conclusion of this study is that the deposition process is dominated by diffusion effects on the substrate surface: the deposition profiles and the deposition rates are determined by the precursor density and by the gas temperature on the substrate surface. The high velocity of the jet does not play a direct role in the deposition mechanism. On the other hand it strongly increases the precursor density available for the deposition since it efficiently transports the precursor up to the substrate.

Read the entire article in the March 2012 Issue

Visit www.asminternational.org/tss

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Kendall Hollis, Seiji Kuroda, and Armelle Vardelle

Scholarship Opportunities



Since 1991, the *International Thermal Spray Scholarship Program* has contributed to the growth of the thermal spray community. ITSA offers up to three Graduate Scholarships worth \$2,000.00 each.

Applications accepted April 15 through June 30 ONLY.

Please visit www.thermalspray.org scholarship area for details and a printable application form.

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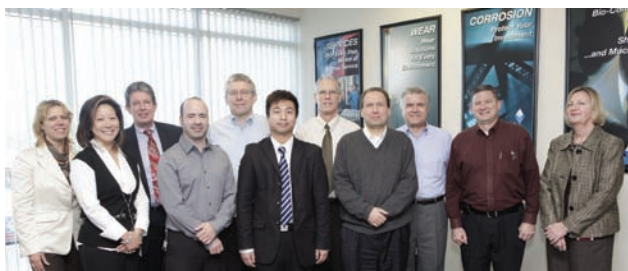
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www.NationCoatingSystems.com

Dr. Wilson Wong Garners 1st Sulzer Metco Young Professional Award (SMYP) for his Research in Cold Spray.

During last year's ITSC in Hamburg, Germany, **Wilson Wong**, a doctoral student at McGill University at the time, was awarded the **Sulzer Metco Young Professionals Award** for his work, "Understanding the Effects of Process Parameters on the Properties of Cold Gas Dynamic Sprayed Pure Titanium Coatings".

Dr. Wilson Wong received a cash prize and an all-expense paid visit to Sulzer Metco's New York facility. In January this year, he met with the company's Executive Management team and had a chance to tour the company's materials and equipment manufacturing operations.



Dr. Wilson Wong (center with tie) with Sulzer Metco staff.

The SMYP award was engendered by Prof. Dr.-Ing. Kirsten Bobzin (IOT, RWTH Aachen University), supported by Dr.-Ing. K. Middeldorf (DVS, German Welding Society), approved by the ITSC Programming Committee and sponsored by Sulzer Metco. It aims to globally attract students, doctoral candidates and scientists, and to encourage new talent to engage in the advancements of surface engineering. The winning recipient is selected during the award session whereby an international academic and industry expert audience votes for the best five minute presentation.

Wilson was enthused by the challenge of presenting his doctoral thesis to the award constituents and states that the process "was quite tricky". "I got up there and I spoke really fast, and I summarized everything - my entire thesis - three years of research presented in 5 minutes. Basically, I did one slide for every chapter of my work".

In December 2011, three months after his presentation in Hamburg, Dr. Wilson Wong received his PhD from the Department of Mining and Materials Engineering at McGill University in Canada. He is a Student Board Member in the ASM Thermal Spray Society Board of Directors and serves on two committees, the Thermal Spray Certification Committee (TSCC) and the TSS Academic Advisory Council (AAC).

To congratulate, email wilson.wong@mail.mcgill.ca

For more information on Sulzer Metco, visit www.sulzermetco.com

4th Thermal Spray Conference at Fabtech Tuesday, November 13

Mark your calendar now for travel to Las Vegas for the fourth annual one-day Thermal Spray Conference.

EnPro Acquires Tara Technologies

EnPro Industries Inc. (NYSE: NPO), a leading manufacturer of engineered industrial products, announced it has acquired Tara Technologies Corporation, a privately-held company that offers highly engineered products and solutions to the semiconductor, aerospace, energy and medical markets. Tara will be combined with the businesses in EnPro's High Performance Seals (HPS) group to form a new EnPro business that will go to market as the Technetics Group.

For more information, visit www.techneticsgroup.com

Technetics Group launches new website

Technetics Group, a leading producer of engineered seals, components and sub-systems for critical applications, has launched a new website, www.techneticsgroup.com. The new, mobile-accessible site includes market-specific content and contact channels, comprehensive product and service information, and technical literature and brochures.

Technetics Group consists of seven recently merged business units that serve the aerospace, nuclear, semiconductor, oil and gas, land-based turbine, medical, pharmaceutical and valve industries. Accordingly the new website consolidates the former sites of Helicoflex, Garlock HPS France, Tara Technologies, Wide Range Elastomers, Plastomer Technologies and Hydrodyne into a comprehensive, user-friendly site.

"Consistent with this consolidation, we felt it was important to combine the websites of these individual businesses into a single, practical resource," says Amy Davis, marketing manager for the Group. "Customers can now easily find all the information they need on one site."

About Technetics Group: Technetics Group, a part of EnPro Industries (NYSE: NPO), provides innovative solutions for the world's most critical and demanding applications, from nuclear reactor pressure vessels to jet engines. Technetics Group is a globally trusted source for engineered components, seals, assemblies, and sub-systems that are custom-designed for high performance and extreme applications in the semiconductor, aerospace, power generation, oil and gas, medical and other industries.

For more information, visit www.techneticsgroup.com



Scholarship Opportunities

Since 1991, the **International Thermal Spray Scholarship Program** has contributed to the growth of the thermal spray community. ITSA offers up to three Graduate Scholarships **worth \$2,000.00 each**.

Applications accepted April 15 through June 30 ONLY.

Please visit www.thermalspray.org scholarship area for details and a printable application form.

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LinkedIn Has Thermal Spray Group

The business social network "LinkedIn" has a group titled "Thermal Spray Coating" **currently with 431 members** and some discussions.

If you are interested, please visit www.linkedin.com and join the network and then join the group.

4th Thermal Spray Conference at Fabtech Tuesday, November 13

Mark your calendar now for travel to Las Vegas for the fourth annual one-day Thermal Spray Conference.

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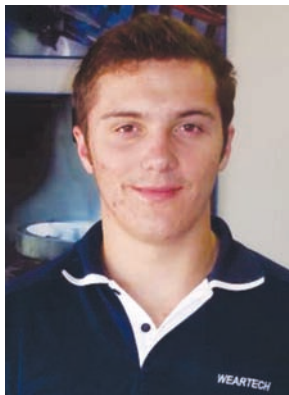
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Weartech Natal Welcomes Brandon Smith



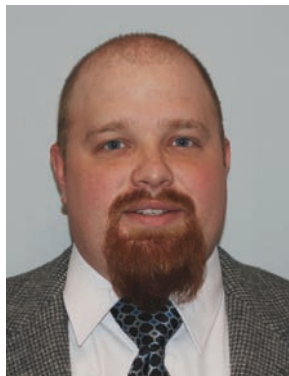
Weartech KZN Durban South Africa has a new staff member. **Brandon Smith** joined 1st October 2011 as a trainee.

Brandon will be trained specifically to support and maintain the Thermal Spray equipment and PTA (Plasma Transferred Arc) machines of Weartech KZN's customers. Brandon will also be assisting in general sales, delivery and stores activities.

He is a friendly and energetic young person who loves to stay active and healthy. Brandon enjoys working with engineering equipment and solving problems. The staff and management of Weartech (Pty) Ltd wish Brandon a successful and happy career.

For more information, visit www.weartech.co.za

Praxair Surface Technologies Appoints Ryan Hinckley Plasma Product Manager



TAFI Incorporated, a Praxair Surface Technologies company, has appointed **Ryan Hinckley** to the position of plasma product manager. Hinckley will work with the company's worldwide sales and distribution network along with the manufacturing and engineering departments in promoting and managing the fast growing plasma equipment product line and driving

profitable sales growth.

Hinckley holds a BS degree in manufacturing engineering from Worcester Polytechnic Institute (WPI). He has six years of diverse experience in thermal spray process development and equipment manufacturing.

Praxair Surface Technologies offers a comprehensive slate of high-performance coatings and technologies to the aviation, energy, and other industries. By continuously advancing coatings technologies, Praxair Surface Technologies helps customers improve environmental performance, decrease energy consumption, extend component life, improve productivity, minimize downtime, reduce operating costs, and produce higher quality products.

For more information on Praxair Surface Technologies, visit www.praxairsurfacetechologies.com.

For more information on Praxair Inc., visit www.praxair.com.

Gilbert Joins Camfil Farr APC in Sales Post



Camfil Farr Air Pollution Control (APC), a leading producer of industrial dust and fume collectors, has appointed **Dale Gilbert** to the position of western regional manager.

Gilbert has 29 years of experience in dust collection and thermal spray applications. He comes to the company after 13 years in sales management positions with Hardface Alloys, Inc. (HAI), Placentia, Calif., a premiere thermal spray system supplier and long-time Camfil Farr APC customer. Prior to that, he held sales positions with Tafa, Inc., Miller Thermal, Inc. and Metallizing Company of America, Inc.

In his new post, Gilbert will work with Camfil Farr APC dust collection customers throughout the western states and will oversee the company's representative and distributor network in this region. Gilbert will also provide sales assistance and support to the company's thermal spray customers nationwide.

Gilbert is a long-standing member of the International Thermal Spray Association (ITSA) and ASM International.

For more information, visit www.farrapc.com.

Richard McCullough joins FW Gartner



FW Gartner is proud to announce the addition of **Richard McCullough** as Global Projects Manager. Richard has spent his entire professional career in the thermal spray industry. He has developed his feel for the craft living on three continents and spending over 17 years in sales, engineering, operations and management. Throughout, his primary goal has been to promote the positive virtues of the technology with energy and enthusiasm.

He joins FW Gartner after 10 years at Sulzer Metco where he was intimately involved in development and commercialization of cutting edge thermal spray ideas, applications and products. Beforehand he spent some years in the UK selling for Eutectic/TAFI and thereafter Plasma and Thermal Coatings in production and application development.

After graduating from the University of Johannesburg in 1994 he started his career selling and servicing thermal spray equipment and consumables for Eutectic/TAFI during the early days where he rapidly figured out the virtues of exceptional customer service required for developing the industry and technology in emerging markets.

For more information, visit www.fwgts.com

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In Memoriam

Thomas F. Bernecki passed away on Tuesday, October 19,



2011 after a long illness. He was 61, and is survived by his wife, Patricia, and daughter, Mara, as well as an extended family of brothers and sisters, nieces and nephews, and grand-nieces and nephews.

Tom graduated with his PhD from SUNY Buffalo in 1982 and for all of his professional life was

an active scientist and researcher of thermal spray processes. Over the years he worked for Perkin-Elmer, Sulzer Metco and lastly, Northwestern University as a Research and Development Scientist.

Tom was author of many technical publications in thermal spray technologies, as well as editor of several proceedings of National Thermal Spray Conferences. He held four patents on plasma spray devices.

Tom was proud of his work, which spanned many aspects of thermal spray and testing, including the development and evaluation of protective coatings for bridges and other infrastructure in various parts of North America and Europe. He enjoyed the extensive travel to many parts of the world that his professional work involved. It was necessary for him to leave active participation in thermal spray technologies in 1997 due to his illness, but Tom maintained personal contacts and keen interest in the field to the end.

Condolences may be sent to Mrs. Patricia Bernecki, 31352 Liberty Road, Grayslake, IL 60030

Ronald "Ron" Lee Harper, 79, passed away on April 14,



2012, leaving an extraordinary legacy of accomplishment, friendships, wisdom and generosity.

Ron and his wife Katherine raised a family of five and spent nearly 40 years of their married life working together in the printing industry.

Ron Harper pioneered the application of thermal spray ceramic

engraved anilox rolls. This revolutionized the anilox cylinder industry. Thermal spray ceramic is the main surface coating of anilox cylinders in the flexographic market today.

In 1971, they founded their own company manufacturing printing press rollers and made it a highly successful business with factories in Charlotte, NC, Wisconsin, Germany and Thailand. Ron Harper was an innovator. He made Harper Corporation the global leader in the printing roller industry and revolutionized printing quality with advanced technology. Ron Harper's business philosophies and achievements are told in one of his books "The Harder I Work, The Luckier I Get." There are flexo departments named for the Harpers at many colleges in the Carolinas as well as in Chicago, California and Wisconsin. CPCC has the Harper Campus "The Harper National Flexographic Center", and manages a Ron and Katherine Harper Scholarship Fund. Appalachian State University dedicated the Katherine Harper Hall in 2007. In 2009, the Harpers generously donated funds to the Clemson University graphics department. Mr. and Mrs. Harper co-chaired a drive in 1999 to raise \$1 million for flexo education in high schools and donated the first \$100,000. They helped establish flexographic printing programs in 21 high schools and 32 colleges in the U.S., Canada, Argentina and Costa Rica with similar technical training programs. Mr. Harper was passionately involved with The Foundation of Flexographic Technical Association and was elected to the FFTA Hall of Fame in 1999.

Charlotte Chamber of Commerce named the Harpers "Manufacturing Champions" in 2007.

Early on in the history of Harper Corporation of America Mr. Harper realized the importance of the thermal sprayed, arc-sprayed and HVOF coatings so on the side of the building for all to see he put "Advanced Surface Technologies Center." Through his leadership the coating department was pushed to produce the best density in the print industry for Cr_2O_3 . The density was needed because the Cr_2O_3 coating would be laser engraved (blind hole drilled) opening as small as 15 microns. Today all ceramic coatings have less than 1% porosity. Over the years his striving for the best Anilox roller drove his company to push all material and equipment suppliers to improve their products and this help to educate all in the importance of the flexographic Anilox roller."

Survivors include: Katherine Harper, his loving devoted wife of 60 years, sons Danny (Lynn), Jim (Heather), Christopher; daughters Margie (Hal) Kluttz, Georgia (Derek) Patterson. Fourteen grandchildren; Ten great-grandchildren. Brothers Dick (Norma) Harper, Gary (Mona) Harper, Steve (Linda) Harper. A special thanks to Candi Lethcoe, Kim Jones and the staff at Stress Free Home Care for their dedication and care.

Condolences may be sent on-line to: www.carothersfuneralhome.com **where you may also view the complete obituary** and life story.

In lieu of flowers memorials may be made to: Gaston Hospice, P.O. Box 3984, Gastonia, NC 28054; or Harper Park, P.O. Box 279, Stanley, NC 28164; or Christ's Evangelical Lutheran Church, Backpack Ministry, 203 S. Main Street, Stanley, NC 28164




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Dr. Sanjay Sampath Appointed Distinguished Professor



Dr. Sanjay Sampath, a faculty member at Stony Brook University, has been appointed to the rank of Distinguished Professor by the State University of New York Board of Trustees. The rank of Distinguished Professor is the University's highest faculty designation.

Dr. Sampath, an ASM Thermal Spray Society and International Thermal Spray Association member, is a Professor of Materials Science and Engineering, an affiliate Professor of Mechanical Engineering and Director of the **Center for Thermal Spray Research (CTSR)** at Stony Brook University. CTSR is a unique interdisciplinary industry-university cooperative research center focused on thermal spray materials processing and surface engineering. The National Science Foundation named CTSR a prestigious Materials Research Science and Engineering Center. He earned his doctorate from Stony Brook in Materials Science in 1989 and spent four years in industry at GTE Sylvania in advanced research, development and processing of refractory metal compounds, inter-metallics and composites, before returning to Stony Brook as a faculty member in 1993.

"Sanjay's leadership, research and dedication make him truly deserving of the Distinguished Professor designation," said Samuel L. Stanley Jr., MD, President, Stony Brook University. "For more than 20 years he has enriched the Materials Science and Engineering department and the entire University. Stony Brook is fortunate to have him on our faculty and looks forward to many more contributions from him in teaching, research and discovery."

"He has made an unusual impact in his field, not only through his basic discoveries, but also through their translation into innovative applications" said Dennis N. Assanis, Provost and Senior Vice President for Academic Affairs.

Dr. Sampath has directed several large multidisciplinary research efforts on a number of federal and industrially-funded programs including serving as Principal Investigator of the NSF Materials Research Science and Engineering Center and on major Defense Advanced Research Projects Agency (DARPA) and Department of Defense (DoD) contracts. Under the auspices of the NSF Center, he directed an interdisciplinary group of approximately 12 faculty members toward a fundamental understanding of thermal spray processes, materials and applications. Through a multi-million dollar DARPA contract Dr. Sampath led a group of investigators in developing disruptive new capabilities in thermal spray; namely new processing tools for direct writing of mesoscale electronics and sensors. These technologies are finding their way into novel applications.



Through his remarkable leadership, CTSR is now self-sustaining and home to the **Industrial Consortium for Thermal Spray Technology**, a group comprised of 35 leading U.S. and multinational companies

aimed at knowledge transfer from fundamental research to application engineering. Thermal spray technology continues to grow and services a broad industrial community; coatings are ubiquitous in gas turbine engines (propulsion and energy), automotive, pulp/paper and infrastructure maintenance. Emerging applications include coatings for orthopedic and dental implants, solid oxide fuel cells and functional sensors for harsh environments.

Dr. Sampath's current research interests lie in thermostructural coatings, thick film materials and multi-functional materials. "I am gratified by this singular recognition from SUNY. These accomplishments would not be possible without the support and collaboration of numerous colleagues both within the United States and around the world," said Dr. Sampath. "In particular, I am grateful to past and present students, without whose dedication and hard work, these achievements would not be possible."

Dr. Sampath was inducted as a Fellow of the American Ceramic Society in 2010. Other awards and honors include: the SUNY Chancellor's Award for Excellence in Scholarship and Creative Activities (2002); Fellow of ASM International (2005); Innovation, Creation and Discovery Award from the Research Foundation of SUNY (2005); Distinguished Visiting Fellow for the University of Auckland, New Zealand (2006); R&D 100 Award (2007) for developing the novel direct write technology, given by R&D Magazine for the 100 most innovative technologies. Additionally, he has more than 200 publications and 13 patents and is the recipient of several best paper awards from conferences and journals.

For more information or to congratulate Sanjay, visit the SUNY Center for Thermal Spray Research website www.ctr-sunysb.org or email ssampath@ms.cc.sunysb.edu

Is Your Employee Listed? Send notice to spraytime@thermalspray.org



Scholarship Opportunities

Since 1991, the **International Thermal Spray Scholarship Program** has contributed to the growth of the thermal spray community. ITSA offers up to three Graduate Scholarships **worth \$2,000.00 each**.

Applications accepted April 15 through June 30 ONLY.

Please visit www.thermalspray.org scholarship area for details and a printable application form.

Mark Beauchemin Joins Bay State



Bay State Surface Technologies is pleased to announce that **Mark Beauchemin** has joined their Sales Team as an Account Manager. Mark brings extensive experience in the wire and materials field, having previously worked for Haynes Wire, Bekaert Corporation, and Tri Star

Metals, among others. Mark will be responsible for key accounts in the aerospace and power generation markets nationally.

Established in 1960, Bay State Surface Technologies manufactures a full line of affordable plasma spray and twin wire arc spray systems. Bay State is also a value-added supplier of thermal spray powders, wire, and turn-key thermal spray solutions. Bay State is part of the Aimtek family of companies, leaders in brazing and welding technologies. Quality certifications include AS9100, ISO9001, Pratt & Whitney, Rolls Royce, Honeywell, and GE.

For more information, please contact Jay Kapur, General Manager, via email jkapur@aimtek.com or visit www.baystatesurfacetech.com.



Appointment of Dr. Kamleshwar Upadhy

Dr.K. Upadhy, FASM, FIM, C.Eng has joined Bender US recently as Vice President of Technology.

Bender US is a world leader in providing thermal spray coatings for industrial wear, corrosion and for friction applications to various industries. Bender US



provides engineered metallic, ceramic and cermets coatings and also custom design coatings according to customer unique requirements. Bender US 100,000 sq ft shop with wide range of machining, grinding and repair capabilities makes Bender US a "One Stop" company for coatings, grindings and repair for industrial parts irrespective of dimensions and sizes.

For over 50 years Bender US has provided a wide range of machines services for turbine, pumps, compressors, conveyers, expanders, loading arms and industrial engines uninterrupted 24 hours 7 days a week. For machine repair, Bender has the people, the experience and expertise to solve your most challenging jobs. Bender US is ISO 9002 Certified for the consistent high quality services.

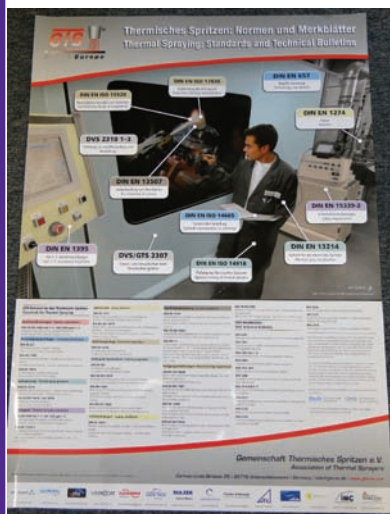
Dr. Upadhy will work in the thermal spray coatings and plasma cladding areas. He brings a wide spectrum of research as well as working experiences and knowledge in the field of thermal xpray coatings, thin film depositions and plasma welding. Dr Upadhy was a Professor at the University of Illinois, Chicago, and has also worked with GE Medical Systems, Hughes STX UDRI. Before joining Bender US, Dr. Upadhy worked at Plasma Technology, CA, as Vice President of Technology and Engineering. Dr. Upadhy holds 22 USA patents and has edited 60 Books. He has received numerous awards for technical papers and journals.

For more information, contact Dr. Upahya via email kamalup@benderus.com, phone 323-232-2371 or visit www.benderus.com

Free DIN Standards Poster

GTS – the Association of Thermal Sprayers – has produced this spectacular new poster of **"Thermal Spraying: Standards and Technical Bulletins"**.

The poster identifies DIN Standards for Thermal Spraying and the DVS Technical Bulletins. The standards/bulletin names are in German and in English.



The poster provides contact information for obtaining the complete version Standards and Bulletins.

The International Thermal Spray Association is proud to be one of the sponsors of this project.

The poster is suitable for framing.

Send request for poster via email to itsa@thermalspray.org.

Join the ASM Thermal Spray Society Online Community Forum

ASM TSS members welcome visitors to register and access the new **searchable** forum, as well as explore the new online community.

To subscribe, visit <http://tss.asminternational.org>, choose networking and forum for instructions.

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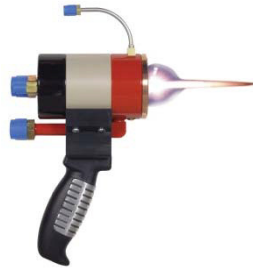
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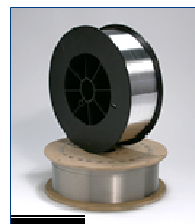
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