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Hexavalent Chromium – What You Need To Know

by Jeff Abelson, Donaldson Company

Hexavalent chromium has become a hot topic in the thermal spray community. New OSHA regulations are forcing everyone to take a close look at their processes and implement changes to them or install engineering controls to help reduce exposure. This article will hopefully answer some of your questions regarding the new regulations including:

- What is hexavalent chromium?
- What are the new OSHA regulations?
- What applications can hexavalent chromium come from?
- How can a worker be exposed?
- What does hexavalent chromium do to the body?
- What are employers and employees required to do if hexavalent chromium is in your facility?
- How do you handle the requests for emissions?

Hexavalent chromium can come in predominantly three different forms. Trivalent chromium which occurs naturally as chrome ore and is also an essential nutrient for proper metabolism, metallic or elemental chromium which is typically found in aerospace alloys and hexavalent chromium which typically comes from industrial processes like welding and thermal spray. Note: Hexavalent chromium is the most toxic form of chromium.

As you are reading through articles and publications you will see hexavalent chromium identified in many different ways, including: Hex Chrome, Chrome VI, CrVI and Cr 6+.

The United States Occupational Safety and Health Administration (OSHA) has defined two levels of exposure for hexavalent chromium. The new Permissible Exposure Level (PEL) for hexavalent chromium is 5 $\mu g/m^3$ in an 8 – hr shift. This PEL of 5 ug/m3 was reduced from 52 $\mu g/m^3$. A factor of 10!. The other level is what is called the Action

continued on page 2

Protecting A Sports Pavilion Steel Structure

One of Metallisation's customers, Brookes Specialist Contractors Limited, has recently completed a major anticorrosion protection project with Bradford Grammar School, using Metallisation MK73 Flame Spray System.

Bradford Grammar School commissioned a new sports pavilion to be constructed using a structural steel frame, which required an aesthetic coating and anticorrosion protection. Electro-Tech CP, representing the Grammar School, appointed Manchester based Brookes Specialist Contractors, to advise on possible coating solutions that would provide both the aesthetic finish and anticorrosion protection.

The recommended and accepted solution was to prepare the steel structure surfaces and apply a protective anticorrosion protection coating 'Asset Guard', using the Metallisation flame spray process. Asset Guard is a sacrificial anode system created by spraying an alloy of aluminium/zinc/indium, which has been specifically developed to provide long-term protection of steel and steel reinforced concrete. The project took four weeks to

continued on page 6

Level (AL) at 2.5 µg/m³. This is the level where employers are required to take specific actions. Failure to take these actions may result in penalties.

Some of the types of industrial processes that can produce hexavalent chromium include:

- Coatings (spray primers/paints)
  - Coatings containing chromates: dyes, paints, inks and plastics
  - Chrome plating
  - Blending/sanding coatings containing chromium
- Welding of alloys containing chromium
  - Stainless steel and nickel alloy
- Thermal spraying, including plasma, electric arc and combustion (including HVOF)
  - Metallic chromium in the feedstock may be converted to the hexavalent form
  - Hexavalent chromium may be present in a feed-stock containing any form of chromium
- Smelting of ferrochromium ore
- Portland cement impurities
- Dip-tanks
  - Anodizing and plating lines
- Maintenance on processes containing hexavalent chromium
  - Machine turnarounds/cleanouts
  - Filter changes on dust collectors
  - Waste material handling
- Leather tanning - ammonium dichromate

If your company has a process that could be producing hexavalent chromium, workers can be exposed through many sources. You can inhale it through your nose and mouth from processes producing dusts, fumes and mists. If a medium containing hexavalent chromium lands on your skin it can be absorbed through the skin. The last way to be exposed is through ingestion (swallowing). If a worker fails to use proper personal hygiene, hexavalent chromium from the exposed area of clothing or skin can land on food, tobacco and cosmetics and be ingested.

Once in the body, hexavalent chrome will typically target certain organs. Respiratory tract (Inhalation damage to mucous membranes), perforation of septum (tissue between the nostrils of nose), lungs, eyes, skin, liver and kidneys are some examples.

A worker exposed to hexavalent chromium may experience some of the following typical symptoms: sinus irritation, nosebleeds, ulcers (stomach and nose), skin rash, chest tightness, wheezing and shortness of breath.

If a company has determined that they could be potentially producing hexavalent chromium, they are required to do the following: implement air sampling, medical monitoring, provide employee notification of monitoring results, implement engineering controls, adopt respiratory protection program, demarcation of work areas containing hexavalent chromium, execute an employee training program and provide availability of OSHA regulations and company policy.

The frequency of air sampling a company must do is dependent on what level of hexavalent chromium was discovered in the facility. If the area tested above the PEL of 5.0 µg/m³ testing has to be done every three months. If the area is above the action level (AL) of 2.5 µg/m³ but below the PEL then a company is only required to do air sampling every six months and if the area is below the action level the company is required to take an initial baseline and then it is left up to the facility hygienists to decide on a sampling frequency. Sampling yearly is a typical strategy in this case.

Medical monitoring of all employees is required in facilities that tested above the AL of 2.5 µg/m³. The standard on hexavalent chromium requires medical surveillance but leaves the selection of the specific tests to the PLHCP (Physician or Licensed Healthcare Professional). Some of the things that a company could do are:

- Review of health and work history
- Physical exam
- Report of the outcome of the exam.

Once an exam is completed, a written summary should be provided within two weeks.

On processes producing hexavalent chromium above the permissible exposure of 5 µg/m³, engineering controls must be implemented. Engineering controls have to be in place and running by May 31, 2010. Until then respiratory protection must be mandatory until engineering controls are implemented. Please note that rotation of employees to different jobs to achieve compliance is NOT permitted by OSHA.

continued on page 4

SPRAYTIME®

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208 Third Street
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United States of America
voice: 440.357.5400
fax: 440.357.5430
email: kathydusa@thermalspray.org
spraytime@thermalspray.org

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INDEX

continued from page 2

Typical particle sizes of the material produced containing hexavalent chromium differ by process and application. Examples include:

- Wet paints w/chromates
  - 0.7 - 34 microns
- Chrome plating
  - 0.75 - 6.4 microns
- Welding/thermal spraying
  - 0.05 – 2.0 microns (80% of total fume in this size)

Welding and thermal spraying can produce significant hexavalent chromium emissions. The amount of hexavalent chromium in the fume may be impacted by:

- Method of welding or thermal spraying
- Electrode type or gun (welding only)
- Base metal material and composition (welding only)
- Powder or wire composition
- Voltage (higher voltages speed production but increase fume rates)
- Electrical current
- Arc length (welding only)
- Shielding gas (welding only)
- Rate of welding or thermal spraying
- Welding angle (welding only).

Some general rules of thumb when it comes to estimating how much hexavalent chrome fume is being produced from a process:

- As melting rate increases – fume generation rate increases
- As the power increases – fume generation rate increases.

The amount of hexavalent chromium in fume can be estimated from the following formula:

E = W x PC x EF x CF

- E = Specific metal emitted, lb/year
- W = Total weight of electrode used [lb/yr]
- PC = Percent composition of specific metal [%]
- EF = Emission Factor per ton of electrode [lb/ton]
- CF = Conversion factor (1 ton/2000 lb).

Emission factors are expressed in a number of different ways:

- % of particulate per pound of electrode
- mg of particulates per pound (lb) of electrode
- Pound of pollutant per pound of electrode consumed.

You can find emission factors from many sources including:

- www.epa.gov
  - www.epa.gov/ttn/chief/ap42/ch12/index.html
  - Compilation of Air Pollutant Emission Factors AP-42
  - For arc welding Section 12.19
- California Air Resources Board http://www.arb.ca.gov/toxics/welding/welding.htm
- National Shipbuilding Research Program http://www.ewi.org/uploads/document_library/white_papers/NSRP%20ASE%20Project.pdf

You can also estimate emission factors by taking the fume generation rate and multiplying by the chrome content and

then multiplying the result by the hexavalent chromium ratio:

- FGR x fume composition x % chrome as Cr6+
- (lb fume/lb electrode) x (lb Cr/lb fume) x (Cr 6+/Cr in fume).

Note EF has no units = [%] x [%] x [%].

A point of clarification is required. In your facility you may be producing a dust, fume or mist that contains hexavalent chromium. It is important to realize hexavalent chromium has its own TLV. It is also important to realize hexavalent chromium is usually only a percentage of the dust fume and mist generated. Other processes will produce a fume containing a small amount of hexavalent chromium. Be advised it is entirely possible that one could exceed the TLV for hexavalent chromium while still being under the TLV for the other fumes given off.

It is expected that exposure should be reduced as far as reasonably practicable

For work area and demarcation of areas that may contain hexavalent chromium, it is expected a company do at least the following:

- Areas with airborne exposure above the PEL must be demarcated with appropriate signage to limit unauthorized entrance
- Location surrounding processes using hexavalent chromium must be free of surface contamination (only wet mopping/HEPA vacuuming). NOTE: Compressed air can only be used under very specific conditions if vacuuming is not feasible.

Companies are expected to make available the regulations for any employee to see. If you would like to research on your own, here are some of many places to go for more information:

- 29 CFR 1910.1026, Hexavalent Chromium can be found on the OSHA webpage:
  - http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARD&p_id=13096
- OSHA Fact Sheet on hex chrome:
  - http://www.osha.gov/OshDoc/data_General_Facts/hexavalent_chromium.pdf

Employees have responsibilities to protect themselves. They are required to use proper personal protective equipment, good housekeeping skills, engineering controls once implemented and good personal hygiene techniques. Good personal hygiene includes not using tobacco, not applying cosmetics, not eating anything, not placing fingers in mouth or nose and washing hands and face prior to doing any of the above activity, before taking a break, or at the end of their shift.

Engineering controls for dusts fumes and mists should include a high initial efficiency filter. Each filter should have at least 1.5 inches of water gage pressure drop across the filters and the capture velocities at the hoods should be as recommended in ACGIH Industrial Ventilation Guide*. Here are some examples:

- VS-90-01 through 03 for Welding
- VS-90-20 for Robotic Welding
- VS-90-30 for Metal Spraying
- VS-90-10 for Torch Cutting
- Laser tables 250 fpm for zone (not covered)

It is highly recommended that ambient collection (sometimes termed general ventilation) NOT be used. Have hoods located as close to the source of generation as possible.

A company that offers help with engineering controls should be able to talk to you about the application variables associated with the process you have in your plant. This person should also be able to help you calculate the airflow required and should be able to help you with estimating how much fume is generated.

In summary, hexavalent chromium is a regulated, toxic material that can be used safely with proper controls, engineering controls where required, if good housekeeping techniques are used and proper personal protective equipment is used and employees use good personal hygiene.

*American Conference of Industrial Hygienists (ACGIH). *Industrial Ventilation: A Manual of Recommended Practice for Design*, Cincinnati, Ohio: Kemper Woods Center, 2007 26th edition

For more information, please contact author Jeff Abelson, IAF Manager of Technical Services, Donaldson Company, Inc., tel: 952.887.3847, email: jeff.abelson@donaldson.co

continued from page 1

complete and in total Brookes Specialist Contractors sprayed over 2150 ft² (200m²) of steel.

Metallisation provided both the MK73 flame spray equipment and full on site training to staff operating the new equipment. Asset Guard can also be applied through arc spraying and Metallisation has provided arc spray equipment, supplies and training to Brookes in preparation for this.

In the Metallisation flame spray process, the raw material in the form of a single wire, cord or powder, is melted in an oxygen-fuel gas flame. This molten material is atomized by a cone of compressed air and propelled onto the steel surface. The molten spray solidifies on the surface to form a dense, strongly adherent coating suitable for corrosion protection. Major advantages of the flame spray process are that the coatings are available for almost instant use with no drying or curing times, neither is there any risk to the component surface being treated. The flame spray process produces a fine coating finish with low porosity, ideal for steel structures and surfaces.

Structural steelwork can be sprayed with a variety of different coatings depending on the circumstances, e.g. pure zinc, pure aluminium and its alloys.

Stuart Milton, Sales and Marketing Manager at Metallisation says: "Our flame spray application is ideal for protecting steel structures from corrosion because of its ease of use on site and the fine surface finish produced. Metallisation and Brookes worked together for many months prior to this project, to ensure the most effective solution was delivered. We are really pleased to be working with Brookes on this exciting new product and look forward to many more projects in the future."

Wayne Brierley, Commercial Director at Brookes, says: "Metallisation's practical assistance proved invaluable on this contract. Together we have delivered a proven engineered corrosion prevention solution that provides our client with greater protection and the desired aesthetic appearance they were looking for."

For further information on surface coatings or the Metallisation equipment and processes, please contact Stuart Milton, tel: +44(0)1384.252.464 or visit www.metallisation.com

EPA Issues Final Air Emissions Standards for Plating and Polishing Area Sources

On July 1, 2008, the United States Environmental Protection Agency (EPA) published the final regulation for plating and polishing area sources in the Federal Register (73 Fed. Reg. 37728). The final rule, 40 CFR Part 63, Subpart WWWWWW, is effective immediately for new affected sources (i.e., those that begin operations on or after July 1, 2008). Existing plating and polishing operations must comply with the new regulatory requirements by July 1, 2010.

The Clean Air Act mandates that the EPA must promulgate standards to control the emissions of hazardous air pollutants (HAPs) from small or area sources. An area source is a facility that emits less than 10 tons per year of a single HAP or less than 25 tons per year of total HAPs. Under the terms of a court order, the EPA was required to issue area source emissions standards for plating and polishing operations by June 2008. The order also set a schedule for the EPA to issue standards for 54 other area source industry categories.

The plating and polishing processes that are subject to the plating and polishing area source rule are those "processes performed at an affected plating and polishing facility that uses or has the potential to emit" any compound of any of the following metal HAPs: cadmium, chromium, lead, manganese, and nickel. This includes electrolytic and non-electrolytic plating and coating processes (e.g., electroplating, conversion coating, sealing, and phosphating), electroforming, dry mechanical polishing, and thermal spray at approximately 2,900 existing plating and polishing facilities.

The final rule does not apply to the following:

- Process that are subject to the Chromium MACT standard (40 CFR Part 63, Subpart N);
- Processes that use cadmium, chromium, lead, and nickel in concentrations of less than 0.1% by weight and manganese in concentrations of less than 1.0% by weight;
- Processes that use metals other than cadmium, chromium, lead, manganese, and nickel;
- Tanks used strictly for educational purposes;
- Thermal spraying processes to repair surfaces; and
- Dry mechanical polishing on a surface prior to plating.

Applicable GACT Standards

The NASF (National Association for Surface Finishing) Government Relations (GR) program has been working closely with EPA officials by providing technical

information on a variety of plating and polishing processes in developing the final rule. As a result of these efforts, the EPA did not establish emission limits for plating and polishing operations, but required plating and polishing facilities to follow management practices as the generally available control technology (GACT) standards. The management practices included using wetting agents in electroplating tanks, and the capture and control of emissions from thermal spraying and dry mechanical polishing.

According to the EPA, additional controls were not necessary because the industry had successfully reduced air emissions through the implementation of management practices and had reduced emissions by 95% since 1990. The EPA estimates the new standards will cost an average of $1,100 per facility for the first three years.

In response to the industry's comments, the EPA made some clarifications in the regulatory language of the final rule and provided a broader array of management practice options for facilities to implement to comply with the rule.

A copy of the final rule is available on the NASF website at www.nasf.org. Over the next several months, NASF will be working with EPA officials to develop compliance guidance for the final plating and polishing area source rule.

If you have any questions or need additional information, please contact Christian Richter of Jeff Hannapel at crichter@thepolicygroup.com or jhannapel@thepolicygroup.com

INDUSTRY NEWS

The Programmable Manipulator

Fifth in a Series from Plasma Powders and Systems

Two points are important regarding programmable manipulators for coating operations. First, by implication, programmable manipulators are generally used in applications where a variety of parts are to be coated. A manipulator dedicated to the coating of a single part is usually not programmable.

Second, programmable manipulators for coating operations are a special breed of manipulators. Palletizing and similar material handling manipulators are designed to move between specific points with only secondary interest in the speed and path followed. On the other hand, coating manipulators are designed to follow specific paths with precise speed control. The end-points are only of secondary interest.

Programmable manipulators can be as simple as a single axis, variable range, variable speed, gun control interfaced with a lathe or turntable. Plasma Powders landing gear spray system is an example of a single axis manipulator. On the other hand, manipulation systems can be as complex as a pair of multiple axes robots; one handing the gun and the other the part being coated.

Early, single or double axis (X-Y or horizontal/vertical) manipulators used DC motors and trips or limit switches. "Programming" consisted of setting limit switch positions and setting the speed of the drive.

Many present day manipulators now use variable frequency drives with "soft limits". End points for each path are "taught". Hard stops are still recommended for these manipulators in order to avoid equipment damage in the event an over-travel condition is encountered.

With the capability and cost effectiveness of present day control systems,

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simple X-Y manipulators can be provided with "memories" to allow for a variety of motion programs to be stored and called-up as needed.

X-Y programmable manipulators can be based on brushless variable frequency AC motors with servo-drives and programmable logic controllers (PLC's). The PLC can also serve as the "Master" over the thermal spray system. PLC based X-Y manipulators can include the following features and functions.

- A hand held teach-pendant for programming the controller at the manipulator.
- Keys or a "Joy Stick" to jog each axis of the manipulator through the desired program path.
- Operator adjustable jog speeds.
- Programming capability to teach each position of the gun during the execution of the program. Points are taught by jogging the manipulator to each program point and then pressing a "teach" key.
- Capability to step through a program and to touch-up each position as necessary for the program.
- Capability to program the speed of motion of each segment when traversing between points.
- Capability to define a "Park" position of the gun for loading and un-loading the parts to be coated.
- Capability to define a "Gun Light/Shutdown" position.
- Digital output signals to start and stop the thermal spray controller, the powder feeder, a turntable and the dust collection system.
- Digital inputs to recognize that the gun is operating, the powder feed is on, the turntable is operating (a zero-speed sensor) and the dust collection system is operating.
- Capability to identify each program, save it and recall it from the teach pendant.
- Capability to back-up the program on a memory unit.

Next time, Robot programming.

For more information, contact series author, Dale Moody via email dalermoody@aol.com

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For more information, contact Victor Champagne, vchampag@arl.army.mil

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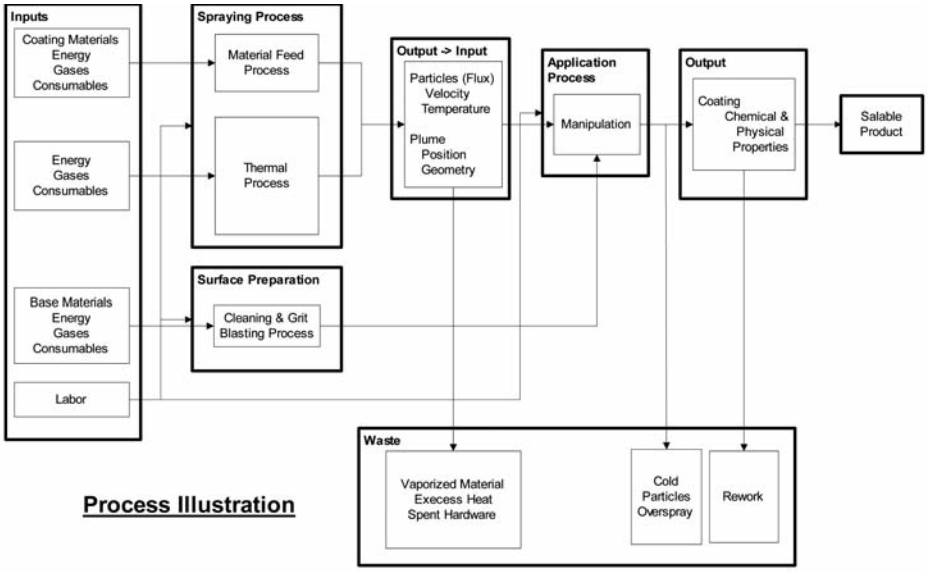
INDUSTRY NEWS

Sprayed Particle Diagnostics

Second in a Series

By Mo VandenBergh - Vandenbergh & Associates

In following with the theme "cost justification of particle diagnostics" in the last issue of SPRAYTIME, the following process flow chart illustrates the thermal spray process proposed in the previous article.

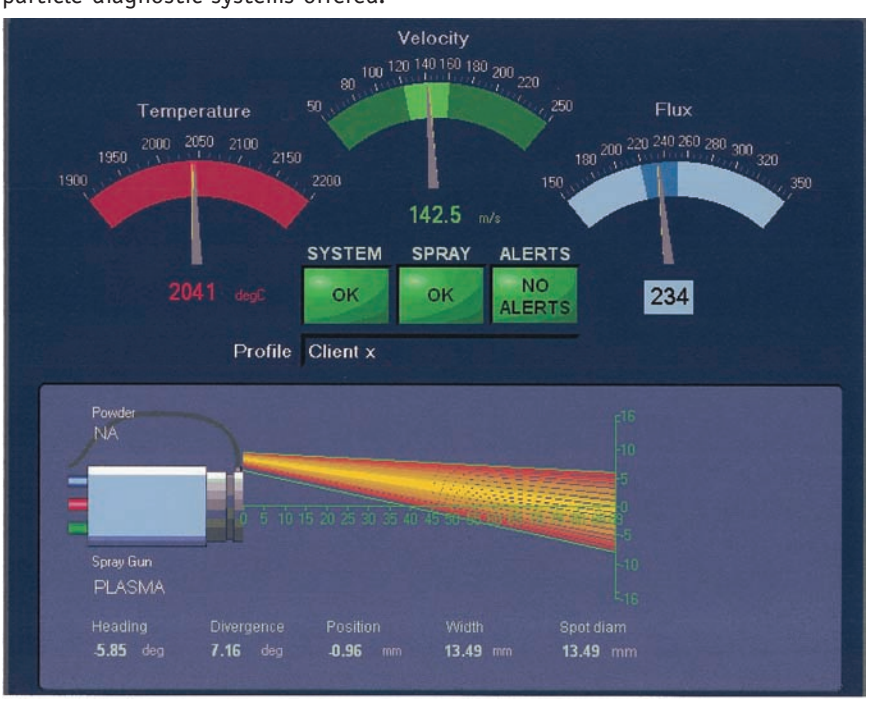


Process Illustration

Illustrated in the flow chart are some of the areas where savings (reduction of waste, and/or better utilization of inputs) can be obtained and applied towards the cost of particle diagnostics. In the last article we promised to give examples of some of these situations.

The most straight forward use of particle measurement, and perhaps the easiest way to "get started" in finding a return on investment, is to take measurements and recordings of what is working well. These data (target values) can then be used to adjust another system that should be producing the same coatings by adjusting the inputs until the same particle and plume characteristics are obtained.

The following screen is an example of the information in the "Output -> Input" box, above (particle and plume information) that can be obtained for one of the available particle diagnostic systems offered.



In this installment we will investigate the concept of using data collected from a spray system working well to adjust another systems or the same system at a different point in time to determine where savings can be obtained. While not presented here, business models have been and can easily be prepared to estimate the bottom line savings on any given scenario along with proposed changes including rework rate, cell utilization, material and energy costs, changes in deposition efficiency, etc.

Case 1 – Cell Equalization

A company has two or more spray cells coating a like part in each. One spray cell (whether located in the same building or another country) is having trouble delivering the finished part, although it appears that all the parameters are the same. By adjusting parameters in the second cell to obtain the particle characteristics obtained in the successful cell, unknown differences in the processes can be identified and corrected or compensated for.

Where is the payback?

- Reduction in rework
  - All the inputs invested in parts to be reworked
  - Large parts and high-priced materials will yield faster returns.
- Decrease in waste stream disposal costs
- Minimization of all inputs of troubleshooting problems which may include cost of added testing
- Increased cell utilization (return on capital and labor)
- Ability to maintain or obtain customers business and expectations
- Elimination of added cost of striping or replacement of substrates.
- Increased deposition efficiency and all the savings associated with it may also apply.

continued on page 16

continued from page 14

Case 2 – Reduced Testing and Cell Certification

A company, on a daily basis, is required to prepare a coupon and test for results before starting the coating of parts.

Associated with historical data and collaborative reports, system settings can be used to adjust particle and plume characteristics to meet target values prior to spraying coupons. The coating process could be continued with improved assurance while sending the coupon for testing or simply holding the coupon as a retained sample.

Where is the payback?

- Increased cell utilization (increased return on capital and labor with increased output)
- Decreased number of tests for approval
- Decreased or elimination of testing costs
- Ability to measure the system output intermittently through out the day
- Reduction of rework
- Increased process efficiencies.

Case 3 – Training of New Spray Technicians

A company hires a new technician who has little if any experience in the operation of spray equipment. To the untrained eyes and ears: pressure gage settings, flow tube readings, amps and volt meter changes don't seem to make much difference. Long waits between the beginning of the coatings and coating results provide little impact or direction on the steps taken next.

With measurable targets and immediate feedback of particle and plume characteristics with changes in parameters, the new spray technician will quickly understand how the process changes with changes in settings. The new operator will, within limits, be able to adjust the system with to meet target values in a much shorter period of time during the process.

Where is the payback?

- All the areas of payback in the previous cases
- Decreased operator training costs.

In the next installments of "Sprayed Particle Diagnostics", the investigation will move beyond the benefits of simple comparisons of processes and more to the gathering of information for the development, optimization and monitoring of thermal spray parameters.

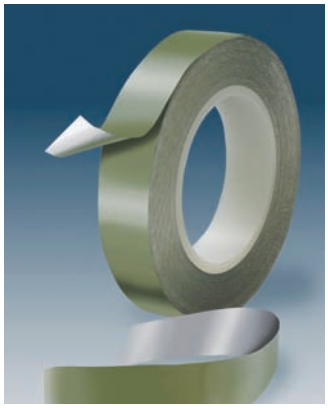
Special note: The screen choice, on page 14, of the plasma plume which appears to, oddly, come from above the gun diagram was made for a reason and will be discussed at a later time. An HVOF plume with axial injection would appear to originate from the center of the gun nozzle and proceed axially.

If you have any questions or suggestions please feel free to contact Mo VandenBergh at VandenBergh & Associates, Inc., 5641 Station Hill Dr., Avon, IN 46123 USA, tel: 317.718.8403, e-mail Mo_VandenBergh@earthlink.net, web site MoVandenBergh.com

SPRAYTIME Circulation Reaches 7000

SPRAYTIME thermal spray industry newsletter has reached a circulation of over 7,000 copies.

DeWAL Offers PTFE-Coated Aluminum Tape



PTFE-coated aluminum reduces friction and wear in dynamic applications.

DeWAL Industries, Inc. is now manufacturing a PTFE-coated foil that combines a thin layer of PTFE with 0.005 in. thick aluminum foil.

The aluminum is coated on the other side with a pressure sensitive silicone adhesive for a sure grip on metal, glass or ceramic surfaces.

The result, D/W 351, is a heat-resistant tape featuring PTFE's chemical resistance, wide operating temperatures and a low coefficient of friction. The foil backing is comprised of a standard 3003 grade of aluminum. Properties are consistent because of the foil's uniform thickness of 0.005 in. with a tolerance of +/- 5%.

DeWAL D/W 351 is used in applications like high volume heat-sealing equipment in food packaging and bagging and as a limited use wear strip. D/W 351 is available in widths from 0.5 in. to 12 in. The roll length is 11 yards.

DeWAL Industries is ISO 9001:2000 registered.

Since it's founding in 1974, DeWAL has become an industry leader in the manufacture of skived PTFE and UHMW-PE films. DeWAL also manufactures pressure sensitive tapes using substrates of PTFE, UHMW-PE, polyimide, and PTFE coated glass fabric. DeWAL also manufactures Poro-Tex and UniPore specialty products providing unique combinations of porosity, chemical resistance and heat resistance for filtration and venting applications.

For more information, contact Christopher Brooks, DeWAL's Director of Sales and Marketing, tel: 800.366.8356, email cbrooks@dewal.com, or visit www.dewal.com

New Self-Dumping Hopper Simplifies Disposal Of Dust From Cartridge Collectors

Farr Air Pollution Control (APC) has introduced a new "Self-Dumping Hopper" that simplifies the disposal of dust captured by cartridge-style dust collection systems. Easier to use than conventional barrels or collection drums, the hopper is offered in two capacities (1 cu. yd. and 2 cu. yd.) and is ideal for a full range of dry dusts, including those that must be reclaimed or recycled after the collection process.

The entire self-dumping hopper assembly is designed to provide easy dust disposal while protecting against unwanted dust leakage between the collector and hopper. A slide gate and flexible quick-disconnect hose connect the two components together, and the hopper lid is fastened with rubber clamps that create a gasketed seal to prevent dust from escaping. When the hopper is full, the user detaches it from the bottom of the collector, lifts the hopper onto a fork truck, and simply pulls a lever to swing the lid open and dump the contents into a larger disposal container.

For further information on the Self-Dumping Hopper, contact Farr APC at tel: 800.479.6801; fax 800.222.6891; or write to Farr APC, 3505 S. Airport Road, Jonesboro, AR 72401; e-mail filterman@farrapc.com; or visit web: www.farrapc.com

Ross-shire Engineering Returns to Corrosion Protection

Metallisation's long-term customer, Ross-shire Engineering, has bought new Flamespray Mark 73 equipment, as part of its strategic decision to once again provide corrosion protection solutions to customers.

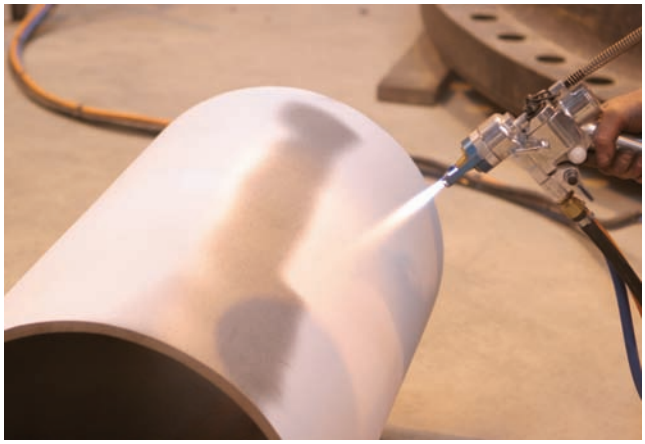
Ross-shire Engineering Ltd, based in the Highlands of Scotland, provides a complete turn-key industrial engineering service to its clients. From small fabrication to power station refurbishment, Ross-shire Engineering has the experience and skills for all types of engineering projects. Now, with the purchase of Metallisation's Flamespray Mark 73, Ross-shire can also provide long-term anti corrosion protection to its customers.

Ross-shire Engineering has been using Metallisation arc spray equipment for around 20 years, producing engineering coatings for shaft repairs and to replace worn bearing surfaces in the water industry, with Scottish Water and Scottish Southern Energy plc being well-established clients. The new flame spray equipment will be used to provide long-term corrosion protection for tubes/pipework, framework structures, security gates and a range of general structural fabrications at water plants throughout the UK.

In the late 1990s Ross-shire provided corrosion protection solutions, but as demand reduced they ceased providing such services. Now, as customers are demanding higher standards of finish and the extended lifetime of capital

equipment, the need for superior corrosion protection is increasing. Ross-shire has responded to such demand by purchasing the flame spray equipment.

Generally customers want to extend the life of their assets by protecting them against corrosion, which in turn means minimum maintenance requirements and reduced lifecycle costs. According to the British and other International Standards Institutes, metal sprayed coatings will protect structures from corrosion for up to, and over, 20 years, depending upon the coating thickness applied and the surrounding environment.



In the flame spray process, the raw material, which is in the form of a single wire, cord or powder, is melted in an oxygen fuelled gas flame. The molten material is atomized by a cone of compressed air and propelled towards the work piece. The molten spray solidifies on the component surface and forms a dense, strongly adherent coating, suitable for corrosion protection or component reclamation. The coating can also be used to provide wear resistance, electrical and thermal conductivity or insulation, or freestanding shapes. Advantages of the flame spray process are that the coatings are available for almost instant use, with no drying or curing time required, and there is no risk of damaging the component.

The flame spray process produces a fine coating finish with low porosity, ideal for steel structures and surfaces. Structural steelwork can be sprayed with a variety of different coatings depending on the circumstances, e.g. pure zinc, pure aluminium and its alloys. The specific system supplied to Ross-shire will spray 3/16 in. diameter zinc and aluminium wires, supplied in 55 lb (25kg) coils. The design of the Mark 73 pistol allows the sprayer to intermittently stop and start the spraying without extinguishing and re-lighting the main flame. This, coupled with the large diameter wire, enables a fast and efficient application of a high quality coating with minimal wastage.

To ensure the highest standards of quality are offered to their customers, Ross-shire also employed Metallisation to fully train their spraying operators at their Muir of Ord site. The training, carried out by one of Metallisation's three service engineers, took place in a new blast and spray facility, specifically built to ensure the highest quality coatings combined with the safety of the operators and local environment. The single day training course included basic principles of metal spraying, health and safety, operation of the system and routine maintenance. All operators attending the course received a certificate of competence.

Ross-shire can provide metal spraying solutions on-site or in-house, depending upon the customer's requirements. Projects can include the refurbishment or the reclamation of equipment and metal spraying new equipment within the distilling, water, power and manufacturing industries. The new flame spray equipment adds another dimension to the services offered by Ross-shire.

Allan Dallas, Operations Director at Ross-shire Engineering, says: "Metallisation was the ideal choice to provide us with corrosion protection equipment. Their existing arc spray system has a proven track record within our company. Their knowledge, expertise and understanding of corrosion solutions, coupled with their after sales service, fits perfectly with the ethos of Ross-shire Engineering. We have a reputation for being pro-active, flexible and reliable so we need a supplier who can support us in delivering the best solution to our customers. The Flamespray Mark 73 is reliable, easy to use and offers flexibility. What more do we need?"

For more information visit www.metallisation.com or call Stuart Milton on +44 (0) 1384 252 464.

Introduction To Single Cathode / Single Anode Cascade Plasma Technology

Part 1 - by Vladimir Belashchenko, Thermal Spray Development, LLC

This paper provides the thermal spray community with a brief introduction to single cathode/single anode Cascade Plasma Technology (CPT) and its potential advantages for plasma spraying.

Plasma spraying is still the largest segment of the thermal spray market. Essentially almost all the commercially utilized plasma systems are based on a conventional high current–low voltage approach. The most popular conventional plasma systems are F4, 3MB, 7MB, 9MB, SG-100 and their modifications manufactured by Sulzer Metco, Praxair TAFA and several other companies. They have done a great job and have allowed the development and implementation of a variety of technologies. Presently it is estimated that more than 5000 plasma systems are in service around the world.

However, further growth of the advanced plasma spray market is limited by the disadvantages of the conventional plasma processes. The major disadvantages are as follows:

- Drifting and instability of plasma parameters resulting in inconsistency of sprayed coatings and a Cpk* on a level 1-1.2 or even less,
- Relatively low deposit efficiency and deposition rate due to low thermal efficiency, pulsing of plasma parameters and maximum electrical power on a level of approximately 60-80 kW or so,
- High operating cost resulting from low deposition efficiency (DE), high flow rates of expensive plasma gases, relatively short life of electrodes on a level of approximately 10-30 hours and some other reasons,
- Narrow operating window which together with plasma parameters instability create significant challenges for the development of advanced robust technologies related to conventional plasma spraying, suspension or solution precursor spraying, powder spheroidization, etc.

*Cpk is a criterion of process capability defined as a distance between an average value of the coating quality parameter and the closest specification limit related to its tripled standard deviation. In power generation, aircraft and some other industries the major production requirement is that the Cpk be greater than 1.33

Multiple research programs, including those carried out in USSR Academy of Science in 70s and 80s and partially summarized in [1], showed that CPT is capable of overcoming the major disadvantages of conventional plasma technologies as listed above.

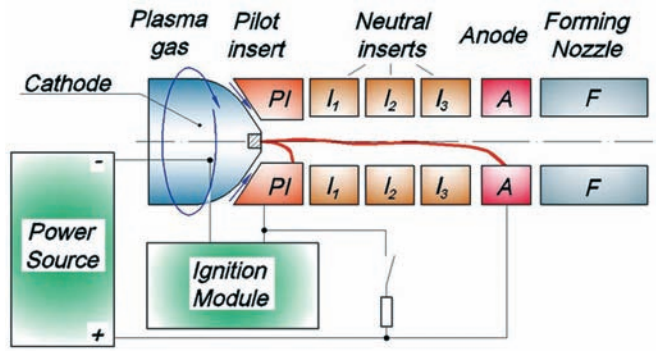


Figure 1. Schematic illustration of cascade plasma system.

A schematic illustration of the CPT system is presented in Figure 1. The system consists of a cascade plasma gun, power source, ignition module, feedstock feeding module (not shown), and a control module that controls electrical parameters and plasma gas flow rates. The cascade plasma gun includes cathode and anode modules, as well as the inter-electrode module that consists of a pilot insert (PI) and one or more electrically insulated inter-electrode inserts (neutral inserts, I in Figure 1). The inter-electrode module extends the arc and practically eliminates undesirable drifting and pulsing of the plasma parameters.

The cascade plasma torch may also include a separate forming nozzle that allows further adjustment of the plasma parameters as dictated by the application requirements. At the start of the process, the pilot arc is initiated between a cathode and a pilot insert. A pilot arc ionizes the gases in a plasma passage between the cathode and the anode, which then allows for the subsequent initiation of the main arc which is attached to the anode.

A CPT gun may include multiple cathodes and/or anodes. For example, the TriplexProTM that is manufactured by Sulzer Metco is based on a cathode module having 3 cathodes. The TriplexPro has demonstrated high stability and a very long electrode life of about 200 hours. However, in a case of multiple electrodes, plasma gases are generally limited to Ar-He mixtures with possible minor additions of N_2 or H_2. The requirement of using only Ar-He based plasma gases narrows down the available operating window related to plasma parameters and doesn't allow the realization of some potential opportunities related to advanced, robust plasma processing and resultant coatings.

A CPT gun may be based on a single cathode/single anode design. Theoretically, this CPT approach allows the elimination of all of the disadvantages of conventional plasma systems and thereby provides the thermal spraying industry with new opportunities. However, known attempts to commercialize CPT in the late 80s – beginning 90s failed due to design flaws and some additional reasons.

TSD LLC (Thermal Spray Development, LLC) was formed by Dr. Vladimir Belashchenko in 2000 with the major mission to develop and implement advanced robust plasma spray

continued on page 24

JOB SHOP MEMBER COMPANIES

Accuwright Industries, Inc. - Gilbert, AZ, USA
www.accuwright.com 480.892.9595
Mr. David Wright, dave@accuwright.com

BASF Catalysts LLC - East Windsor, CT USA
www.basf.com 860.623.9901
Mr. Marc Froning,marc.froning@basf.com

Bender Machine & Surface Technologies, Inc.
Vernon, CA USA www.benderus.com 323.232.2371
Mr. Doug Martin, doug.martin@woodgroup.com

Cascadura Industrial S.A. - Sorocaba SP Brazil
www.cascadura.com.br 55.15.3332.9620
Mr. Ricardo Leoni, ricardo.maffei@cascadura.com.br

Cincinnati Thermal Spray, Inc. - Cincinnati, OH USA
www.cts-inc.net 513.793.0670
Mr. Bill Menth, bmenth@cts-inc.net

Ellison Surface Technologies, Inc. - Cincinnati, OH USA
www.ellisonsurfacetech.com 513.770.4924
Mr. David Terkosky, dterkosky@ellisongroup.com

Exline, Inc. - Salina, KS USA
www.exline-inc.com 785.825.4683
Mr. Doug Porter, d.porter@exline-inc.com

F.W. Gartner Thermal Spraying - Houston, TX USA
www.fwgts.com 713.225.0010
Mr. Jimmy Walker, jwalkerjr@fwgts.com

Ferrothermal Spray Coating - Monterrey N.L. Mexico
www.drexel.com.mx 52.818.331.0816
Mr. Renato Drexel, renato@drexel.com.mx

Harper Corporation of America - DePere, WI USA
www.harperimage.com 704.588.3371
Mr. Lee Kluttz, lkluttz@harperimage.com

Hayden Corporation - West Springfield, MA USA
www.haydencorp.com 413.734.4981
Mr. John O. Hayden, john@haydencorp.com

Machine-Aid Tech Philippines, Inc. - Sucat, Muntinlupa City, Philippines 632.838.7551 to 54
Mrs. Marivic R. Dela Cruz, matpi@vasia.com

Nation Coating Systems - Franklin, OH USA
www.nationcoatingsystems.com 937.746.7632
Mr. Larry Grimenstein, ncslgrimen@aol.com

National Coating Technologies Inc. - Winnipeg, MB Canada
www.nationalcoating.com 204.632.5585
Mr. John Read, johnr@nationalcoating.com

Nooter Construction Company - Trevose, PA USA
www.nooterconstruction.com 215.244.3526
Mr. Mike Murphy, mjmurphy@nooter.com

Plasma Coatings - Union Grove, WI USA
www.plasmacoatings.com 262.878.2445
Mr. Daniel Cahalane, info@plasmacoatings.com

Plasma Technology, Inc. - Torrance, CA USA
www.ptise.com 310.320.3373
Mr. Robert D. Dowell, salespti@ptise.com

St. Louis Metallizing Company - St. Louis, MO USA
www.stlmetallizing.com 314.531.5253
Mr. Joseph P. Stricker, jpstricker@stlmetallizing.com

Sermatech International, Inc. - Limerick, PA USA
www.sermatech.com 610.948.5100
Mr. Thomas F. Lewis III, tlewis@sermatech.com

Spraymetal, Inc. - Houston, TX USA
713.921.0012
Mr. Jim Hollingsworth, jimh@schumachercoinc.com

Superior Shot Peening, Inc. - Houston, TX USA
www.superiorshotpeening.com 281.449.6559
Mr. Albert Johnson, ajsspi@aol.com

Surface Modification Systems - Santa Fe Springs, CA USA
www.surfacemodificationsystems.com 562.946.7472
Dr. Rajan Bamola, rajanb@surfacemodificationsystems.com

Thermal Spray Technologies, Inc. - Sun Prairie, WI USA
www.tstcoatings.com 608.825.2772
Mr. Bill Lenling, blenling@tstcoatings.com

United Surface Technologies - Altona, Melbourne Australia
61.393.98.5925
Mr. Keith Moore, kmoore@ust.com.au

SUPPLIER MEMBER COMPANIES

3M Abrasive Systems Division - St. Paul, MN USA
www.mmm.com 800.362.3550 or 651.736.5459
Mr. Troy Heuermann, twheuermann1@mmm.com

Action SuperAbrasive - Brimfield, OH USA
www.actionsuper.com 800.544.5461
Mr. Dan Noonan, noonand@actionsuper.com

Air Products and Chemicals - Allentown, PA USA
www.airproducts.com/metals 800.654.4567
Mr. Stewart Stringer, stringrs@airproducts.com

Alloy Sales - Delta, BC Canada
www.alloysales.com 604.940.9930
Mr. Lloyd Johannesen, lloyd@alloysales.com

AMETEK, Inc. - Eighty-Four, PA USA
www.ametekmetals.com 724.250.5182
Mr. Richard Mason, dick.mason@ametek.com

Ardleigh Minerals, Inc. - Shaker Heights, OH 44122 USA
www.ardleigh.net 216.921.6500
Mr. Ernie Petrey, epetrey@ardleigh.net

Bay State Surface Technologies, Inc. - Millbury, MA USA
www.aimtek.com/baystate 508.832.5035
Mr. Jay Kapur, jkapur@aimtek.com

Carpenter Powder Products - Pittsburgh, PA USA
www.carpenterpowder.com 412.257.5102
Mr. Chip Arata, warata@cartech.com

Centerline Windsor Limited - Windsor, ON Canada
www.supersonicspray.com 519.734.8464
Mr. Julio Villafuerte, julio.villafuerte@cntrline.com

Deloro Stellite Company, Inc. - Goshen, IN USA
www.stellite.com 574.534.8631
Mr. David A. Lee, dlee@stellitecoatings.com

Donaldson Company, Inc. - Minneapolis, MN USA
www.donaldson.com/en/industrialair 800.365.1331
Ms. Lori Lehner, llehner@mail.donaldson.com

Farr APC - Jonesboro, AR USA
www.farrapc.com 800.479.6801
Mr. Lee Morgan, morganl@farrapc.com

Flame Spray Technologies, Inc. - Grand Rapids, MI USA
www.fst.nl 616.988.2622
Mr. Terry Wilmert, twilmert@aol.com

Fujimi Inc. - Arlington Heights, IL USA
www.fujimico.com 847.398.6544
Mr. Michael Akiyoshi, makiyoshi@fujimico.com

Genie Products, Inc. - Rosman, NC USA
www.genieproducts.com 828.862.4772
Mr. Richard Grey, rwgrey@genieproducts.com

Green Belting Industries LTD - Mississauga, ON, Canada
www.greenbelting.com 905.564.6712
Mr. Tim Connelly, timconnelly@sympatico.ca

H. C. Starck, Inc. - Newton, MA USA
www.hcstarck.com 513.942.28155
Mr. Jim Ryan, james.ryan@hcstarck.com

HAI Advanced Material Specialists - Placentia, CA USA
www.hardfacealloys.com 877.411.8971
Mr. Daren Gansert, dgansert@haiams.com

Haynes Wire Company - Mountain Home, NC USA
www.haynesintl.com 828.692.5791
Mr. Robert Jenkerson, rjenkerson@haynesintl.com

Kennametal - Houston, TX USA
www.kennametal.com 281.387.4287
Mr. Eric Hanson, eric.hanson@kennametal.com

Lineage Aloys - Baytown, TX USA
www.lineagealloys.com 281.426.5535
Mr. Gordon Jones, gjones@lineagealloys.com

Linde Gas USA LLC - Murray Hill, NJ USA
www.us.linde-gas.com 908.771.1353
Dr. Joe Berkmanns, joachim.berkmanns@us.linde-gas.com

Metallisation Limited
Dudley West Midlands, United Kingdom
www.metallisation.com +44.1384.2524646
Dr. Terry Lester, rd@metallisation.com

North American Höganäs - Hollsopple, PA USA
www.hoganas.com 814.361.6857
Mr. Jim Morris, jim.morris@nah.com

Northwest Mettech Corporation
North Vancouver, BC Canada
www.mettech.com 604.987.1668
Mr. Alan Burgess, alan.burgess@mettech.com

Osram Sylvania - Towanda, PA USA
www.sylvaniathermalspray.com 570.268.5398
Ms. Stacy Garrity, stacy.garrity@sylvania.com

PM Recovery, Inc. - Harrison, NY USA
www.pmrecovery.com 860.536.5396
Mr. Paul Sartor, paul@pmrecovery.com

Parker Hannifin, domnick hunter Division
Charlotte, NC USA
www.domnickhunter.com 800.345.8462
Mr. Jim Tomczyk, jim.tomczyk@parker.com

Plasmatec, Inc. - Montreal, Quebec Canada
www.plasmatec.com 514.931.1301
Mr. Michael Hacala, info@plasmatec.com

Polymet Corporation - Cincinnati, OH USA
www.polymet.us 513.874.3586
Mr. Bob Unger, runger@polymet.us

Powder Alloy Corporation - Loveland, OH USA
www.powderalloy.com 513.984.4016
Mr. Steve Payne, spayne@powderalloy.com

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

Progressive Technologies, Inc. - 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

Soleras LTD - Biddeford, ME USA
www.soleras.com 207.282.5699
Mr. Guy Laverriere, guy@soleras.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, davelewisen@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
www.asminternational.org 440.338.5151
Mr. Thom Passek, tspassek@asminternational.org

R.A. Miller Materials Engineering - Indianapolis, IN USA
www.ram-mat.com 317.259.7632
Mr. Robert Miller, robert_a_miller@mymailstation.com

State University of New York at Stony Brook
Stony Brook, NY USA
www.matscieng.sunysb.edu/tsl/ctsr 631.632.45678
Ms. Lysa D. Russo, lysa.russo@sunysb.edu

The Zanchuk Group, LLC - Concord, NH USA
www.zanchuk.com 603.226.3712
Mr. Val Zanchuk, zanchuk@comcast.net

International Thermal Spray Association
Headquarters Office
208 Third Street • Fairport Harbor, Ohio 44077
voice: 440.357.5400 • fax: 440.357.5430
email: itsa@thermalspray.org
web: 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 closely tied to most major advances in thermal spray technology, equipment and materials, industry events, education, standards and market development.

Chairman Froning

A company-member trade association, ITSA invites all interested companies to talk with our officers, committee chairs, and company representatives to better understand member benefits. A complete list of ITSA member companies and their representatives are at www.thermalspray.org

ITSA Mission Statement

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

Officers

Chairman: ***Marc Froning***, BASF Catalysts LLC
Vice-Chairman: ***Dan Hayden***, Hayden Corporation
Treasurer: ***Bill Mosier***, Polymet Corporation
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John Read, National Coating Technologies
Scott R. Goodspeed, H. C. Starck, Inc.
John Hayden, Hayden Corporation
Joeseph Stricker, St. Louis Metallizing Company

ITSA Scholarship Opportunities

The International Thermal Spray Association offers annual Graduate and Undergraduate 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 Materials Camp Student Sponsor

Commencing in 2001, the International Thermal Spray Association provides an annual $1,500 student scholarship to the ASM International Foundation Materials Camp.

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, Ohio 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 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.

For a free *SPRAYTIME* subscription, visit www.spraytime.org and complete the short questionairre.

ITSA Headquarters

208 Third Street, Fairport Harbor, Ohio 44077 USA
tel: 440.357.5400 fax: 440.357.5430
itsa@thermalspray.org www.thermalspray.org

SCHOLARSHIP OPPORTUNITIES

Up to two(2) Graduate scholarships worth $2,000.00 each to be awarded each calendar year.

Up to three(3) Undergraduate scholarships worth $750.00 each to be awarded each calendar year

Since 1991, the ITSA Scholarship Program has contributed to the growth of the Thermal Spray Community, especially the development of new technologists and engineers. The International Thermal Spray Association is very proud of this education partnership and encourages all eligible participants to apply.

New Application Dates: Scholarship applications are now accepted annually April 15 through June 30 ONLY for both the Graduate and Undergraduate scholarships.

Please visit WWW.THERMALSPRAY.ORG Scholarship area for details and a printable application form.

Become a Member of The International Thermal Spray Association

Your company should join the International Thermal Spray Association now! As a company-member, professional trade 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.

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, in every issue of SPRAYTIME, as well as in our free edition of "What Is Thermal Spray?". ITSA members also receive an additional 10% advertising discount in the SPRAYTIME newsletter. ITSA member companies are also highlighted in the ITSA booth at several trade shows throughout the year (International Thermal Spray Conference ITSC, Fabtech International and AWS Welding Show Thermal Spray Pavilion, Weldmex Mexico, and TurboExpo in 2008).

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 our headquarters office or our membership chairman Jim Ryan at james.ryan@hcstarck.com or visit the membership section of our www.thermalspray.org website.

ITSA Thermal Spray Pavilion
at
Fabtech International & AWS Welding Show
Las Vegas • October 6-8, 2008
***For booth space*, contact Joe Krall,**
jkrall@aws.org, 800.433.9353 x 297
***For event information*, visit www.aws.org/expo**

International Thermal Spray Association Welcomes New Members

Fujimi Incorporated has joined the International Thermal Spray Association.

The Fujimi manufacturing complex in Tualatin has been built in phases, beginning in 1993 with a facility for the production of Disklite polishing slurries. A 45,000 square feet building devoted to the production of FO lapping powders was completed in 1996. It is one of the most advanced facility of its type in the industry. This plant is highly automated and fitted with state-of-the-art environmental controls. Their Technical Center , dedicated to testing of Fujimi products, was constructed at the same time. It was the beginning of the research and development of advanced finishing processes in the US. A production facility for CMP products was begun in 1998, and is continually being expanded and upgraded to meet the demands of a growing market. Currently four CMP products are being made on a 24/7 schedule.

In July of 2003, Fujimi Corporation was merged with Fujimi America , maintaining the name Fujimi Corporation as the US company, located in Tualatin , Oregon. A building containing administrative offices, expansion space for CMP production, an ultra clean automated CMP process facility, and several state-of-the-art laboratories for R&D was completed on the Tualatin site just before the merger. Further expansion in Tualatin is being planned, as well as upgrades to the PWA plant in Wilsonville.

For more information, contact ITSA company representative Michael Akiyoshi, tel: 847.398.6544, makiyoshi@fujimico.com, web: www.fujimico.com

Plasma Coatings has joined the International Thermal Spray Association.

The Plasma Coatings Division of American Roller Company provides cost-effective solutions to a variety of manufacturing problems across many industries. Their coatings enhance the surface properties of production equipment where toughness, abuse resistance, and longevity are required. Drums, rollers, guide plates, vats, and more all can be improved to provide better performance.

Plasma Coatings also offers a staff of research and engineering personnel to help determine the best product for your application. Plasma Coatings is confident there is at least one area in your operation where their coating services will help your equipment run more efficiently and be more productive.

For more information, contact ITSA company representative Daniel J. Cahalane, 262.878.2445, email: info@plasmacoatings.com, web: www.plasmacoatings.com

continued from page 19

systems based on CPT philosophy and to satisfy the major market needs as follows:

- Robustness and advanced plasma parameter stability with Cpk>1.33
- High deposit efficiency on a level of 65-85% and thereby significantly higher production rates
- Long service life of electrodes exceeding at least 50-100 hr
- Capability of reproducing almost all existing plasma spraying parameters and coatings with improved coating homogeneity and properties
- Broad range of plasma gases, and flow rate flexibility to provide a wide operating plasma enthalpy/velocity window.

The first commercial Cascade Plasma system with power range of 10-100 kW was integrated and tested in the US early in 2008. CPT operating voltage is up to 250 V and operating current is up to 400 A. It is presently available for evaluations, coating development, and further implementation. Commercial manufacturing of CPT systems will begin in early Fall of 2008.

Testing and experimentation in 2007-2008 have confirmed all of the advantages of CPT which may be summarized as follows:

- The CPT cascade plasma torch is capable of efficiently generating stable plasmas with, no drifting or pulsing with an extremely wide and unique range of plasma enthalpies of 10-70 kJ/g. The thermal efficiency of cascade torches at high plasma flow rates reaches 75-80%, which is significantly above the usual 50-55% achievable from conventional plasma torches. Average DE data are 10-20% better in comparison with conventional plasma DEs.
- The wide operating window allows the reproduction of plasma parameters and related coatings of practically all plasma guns/systems that are presently commercially available in the marketplace. Therefore, the users of plasma systems find that this technology is highly desirable when a more stable and efficient process is needed to improve the production of the existing coatings.
- The cascade design has the capability of generating laminar, transient and turbulent plasmas using different plasma gases with parameters presently not achievable with any existing plasma system:
  - Figure 2 shows a transient nitrogen plasma plume with the length of above 10 in. (25 cm).
  - A quasi-laminar plasma may be of special advantage for applications such as suspension spraying, powder spheroidization, etc., when a long dwell time is needed to achieve a desirable result.
  - Finally, the extremely wide operating window could allow the development of better or even completely new coatings and applications and create presently unavailable, attractive new opportunities in the OEM market.
- No measurable erosion of electrodes within ± 0.01 g was observed during the 20-hour endurance tests using nitrogen as a plasma gas. Therefore, advantages could be expected. such as no possible contamination of coatings by electrode erosion products, long service life (exceeding at least 100 hr), extended production cycles, and low replacement costs.
- Plasma gas selection presently includes N_2, N_2-H_2, N_2-Ar, Ar, Ar-H_2, Ar-He. The capability of using inexpensive nitrogen to generate plasmas should allow for the expansion of the business in developing countries where high purity Ar, He, H_2 are expensive and not readily available.

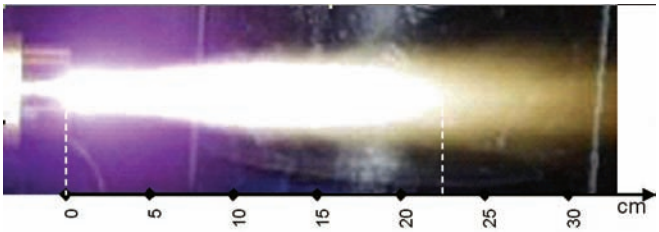


Figure 2. Illustration of transient nitrogen plasma. The length of the plasma plume is above 10 in. (25 cm).

Additional experimental data regarding deposition rates and efficiencies, as well as coating structures and properties will be published in a future article.

For more information, contact author Vladimir Belashchenko at vbelashchenko@comcast.net

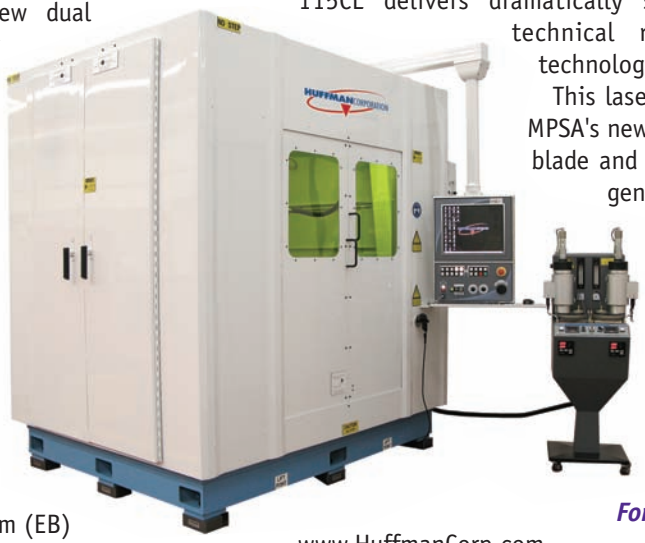
[1] Thermal Plasma and New Materials Technology. Volume 2: *Investigations and Design of Thermal Plasma Technologies*. Editors: O.P.Solonenko and M.F.Zhukov. Cambridge Interscience Publishing, 1995.

WHERE IS YOUR ARTICLE?

You and your company have the opportunity to help design the content of your thermal spray community newsletter. The *SPRAYTIME* Editorial Staff encourages and welcomes your contribution.

Huffman Announces New Dual Capacity Multi-Axis Laser Powder Fusion Welding System

Huffman Corporation, located in Clover, South Carolina, announces the sale of their new dual capacity multi-axis Laser Powder Fusion Welding System to Mitsubishi Power Systems Americas, Inc., in Orlando, Florida, with delivery in 2008. This system offers laser powder fusion welding (a.k.a. cladding) for restoration of tips, Z-notches, and other wear surfaces on turbine components like blades, vanes and shrouds.



The system also has the capacity for laser fusion welding without powder, a process which replaces operations traditionally done with much more expensive electron beam (EB) welding technology. The model HP-115CL system includes Huffman's industry-leading integrated vision and programming systems to automatically adjust to incoming part variation, a critical requirement for engine-run components.

In addition to Huffman's legendary reliability, the HP-115CL delivers dramatically superior commercial and technical results than alternative technologies.

This laser system will be housed in MPSA's new 111,500 sq. ft gas turbine blade and vane manufacturing power generation service facility. The $64.5M dollar investment was scheduled to be opened May 2008. MPSA plans to start producing parts by mid-summer to accommodate customer requirements for Fall outage support.

For more information, visit www.HuffmanCorp.com

For a free copy of "What Is Thermal Spray?" publication, send request to itsa@thermalspray.org

WHERE IS YOUR ARTICLE?

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Deloro Stellite Acquires Plasmatec Inc.

Deloro Stellite Group, a world leader in wear solutions, announced today that its Canadian division, Deloro Stellite Inc., has purchased Plasmatec Inc., a Montreal based company specializing in thermal spray coatings, abradable powder manufacturing and the distribution of thermal spray materials and equipment.

(left to right) Deloro Stellite representatives David Lee, Dr. Volker Hellinger, Shelby Hacala (Plasmatec), Dr. Hubert Bick, Mauro Bianchi. Photo taken at ITSC 2008, the Netherlands.

Plasmatec has been in existence since 1985 and has a solid reputation in the thermal spray industry. Plasmatec's commercial focus on the land-based power generation, aerospace, mining, oil and gas sectors provides the opportunity for future market synergies with the existing businesses of Deloro Stellite.

Additionally, the acquisition of Plasmatec will add operational strength to our existing facility in Montreal (Deloro Stellite Surface Technologies, Baie d'Urfe), which offers a unique integrated processing solution to landing gear manufacturers. The combined strength and synergies of these two companies will give Deloro Stellite a leading position in the Montreal area with four spray cells (HVOF, plasma, G4HVAF), grinding and super finishing capabilities, strong R&D capabilities and a laboratory certified by NADCAP, Goodrich, Messier-Dowty, Pratt & Whitney and SAFRAN).

The Plasmatec acquisition is part of Deloro Stellite's strategy to grow its coating services business globally.

John Crane Hardfacing Department Acquired

Deloro Stellite Group acquires the Hardfacing Department of John Crane Italy to form Deloro Stellite S.r.l. in Bellusco, Italy

The Italian welding and thermal spray market has shown very good growth potential for several years. On April 15, 2008, the Deloro Stellite Group created Deloro Stellite, S.r.l by acquiring the hardfacing department of John Crane Italy, to take advantage of this opportunity and expand our capability to customers in the growing thermal spray and welding markets.

The new entity specializes in hardfacing parts for different industries, with focus on valve, steam and gas turbine applications, and will be a direct subsidiary of Deloro Stellite Holding GmbH & Co KG based in Koblenz, Germany. The objective is to grow this business through extended use of the existing capacity and selective investments. Along with hardfacing for the Italian markets, Deloro Stellite, S.r.l. will offer additional services, including all types of machining and repair work requiring high tech PTA, JetKote® HVOF and plasma spray.

This acquisition strengthens Deloro Stellite's position in the expanding hardfacing services sector and extends our geographic reach with yet another coating services facility in Europe, adding the recent additions in Houston (USA), Montreal (Canada), New Delhi (India) and Perm (Russia).

Deloro Stellite is a global provider of wear solutions, manufacturing cast or finished machined investment castings, sand castings, centrifugal castings and resin shell castings as well as components made by the powder metallurgy process and Stellite® 6B or Stellite®6K wrought products.

The company also offers various coating services such as Jet Kote® HVOF thermal spray, Starweld® and Hettiger plasma transferred arc (PTA), plasma spray, spray and fuse, manual torch/powder welding, tungsten inert gas (TIG), oxy-acetylene, Submerged arc, metal inert gas (MIG) and wire spray - providing a full range of wear resistant, corrosion resistant and abrasion resistant solutions.

In addition the company manufactures a wide variety of hardfacing alloys in form of cobalt rod and nickel rod, cobalt wire and nickel wire, cobalt powders, nickel powders and tungsten carbide powders and coated electrodes.
The company's products are made from cobalt alloy, nickel alloy, tungsten carbide and other super alloys.

Its main brand names are Stellite®, Deloro®, Tribaloy®, Delcrome®, Jet Kote®, T-400®, Starweld®, Hettiger.

For more information, visit www.stellite.com

Deloro Stellite Surface Technologies, Montreal, Achieves Nadcap Accreditation and AS 9100 Registration

Deloro Stellite Surface Technologies in Montreal, a Division of Deloro Stellite Group has received Nadcap Accreditation for coatings, thermal spray, stripping, coatings evaluation (AC7109/1/4/5), and quality system (AC7004). They have also achieved AS 9100B/ ISO 9001:2000 quality system registration. These accreditations complement the customer certifications that we have already received from Goodrich Landing Gear (coatings, grinding - HVOF and chrome, and stripping), Messier-Dowty (coatings, grinding- HVOF and chrome and stripping) and Boeing (grinding – chrome).

Deloro Stellite Surface Technologies has a strategic alliance with Tecnickrome Aeronautique Inc. to provide a first class, leading edge, one-stop-shop integrated processing solution for the world wide aerospace industry. The Montreal facility consists of multiple HVOF coating cells, chemical stripping process, as well as comprehensive grinding and super finishing capabilities required to finish the tungsten-carbide coatings. The alliance with Tecnickrome completes the suite of complimentary technologies and capabilities which are required for high strength landing gear parts. Operationally this alliance will function as a one-stop shop, which will ensure the benefits of integrated planning and the subsequent production flexibility.

The Deloro Stellite Group is renowned for its range of STELLITE® alloys, and has provided wear and corrosion resistant coatings and alloys for nearly 100 years. In addition to the facility in Montreal, the company has HVOF coating facilities in the USA, UK, Germany, and China.

Tecnickrome Aeronautique Inc is a leading provider of metallic surface treatments for the aeronautical market, and is known for its integrated services philosophy. The company offers a variety of plating processes such as chrome, cadmium, Ti-Cad, nickel, as well as the associated heat treatment, shot-peening, and a variety of non-destructive testing techniques. (www.tecnickrome.com)

For more information, contact Deloro Stellite Surface Technologies, Curt Glasgow, email: cglasgow@stellite.com, 19300 Clarke-Graham Ave, Baie d'Urfe, Québec, Canada H9X3R8, tel: 514.457.3053, fax: 514.457.0238 or visit www.stellite.com

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ITSA Thermal Spray Pavilion
at
Fabtech International & AWS Welding Show
Las Vegas • October 6-8, 2008
For booth space, contact Joe Krall, jkrall@aws.org, 800.433.9353 x 297
For event information, visit www.aws.org/expo

CALENDAR OF EVENTS

AUGUST 2008

18-21 Louisville, KY USA - *MegaRust 2008 Marine Coatings & Corrosion Conference* - visit www.nstcenter.com

18-20 Sugarland, TX USA - *Alloys and Coatings: Applications in Combustion Turbines* - visit www.matsolint.com

SEPTEMBER 2008

2-3 Hanover, Germany *Aluminum Brazing Seminar* **-** by European Assoc for Brazing and Soldering- visit EABS Secretariat website at www.brazingandsoldering.org

8-11 Memphis, TN USA *SAMPE Fall Technical Conference* - Society for the Advancement of Materials and Process Engineering, www.sampe.org

14-18 Champion, PA USA *11th Int'l Symposium on Superalloys (Superalloys 2008)* - contact TMS tel: 724.776.9000 x 243, email: mtgserv@tms.org, web: www.tms.org

23-25, Toronto, Canada *Canadian Manufacturing Week with Weld Expo Canada* **-** visit www.cmwshow.ca, tel: 888.322.7333

29 SEP-1 OCT Mannheim, Germany *EuroPM2008 Int'l Conference* - contact European Powder Metallurgy, tel: +44(0)1743.248899, web: www.epma.com

OCTOBER 2008

6-8 Las Vegas, NV USA *FABTECH Int'l & AWS Welding Show* - ***with a Thermal Spray Pavilion*** - organized by American Welding Society, www.aws.org, Fabricators and Mfgrs Assoc, www.fmafabtech.com, Society of Manufacturing Engineers, sme.org/fabtech

6-9 Pittsburgh, PA USA *Materials Science & Technology 2008 Conference & Exhibition (MS&T'08)* - organized by ASM, ACerS, AIST, and TMS tel: 440.338.5151 customerservice@asminternational.org, web: www.asminternational.org

15-16 Hartford, CT USA *TSS Aerospace Coating Symposium* **-** contact ASM Int'l tel: 440.338.5151,web: www.asminternational.org, email: customerservice@asminternational.org

29-30 Paris, France *Industrial Gas Turbine O&M Conference* - contact Ruth Martin, email ruth@gasturbine-events.com, tel: +44 207 932 5587,

DECEMBER 2008

1-5 Boston, MA USA *2008 MRS Fall Meeting & Exhibit* - contact MRS tel: 724.779.3003, email: info@mrs.org, web: www.mrs.org

2-3 Montreal, Quebec Canada *Symposium on Improving Reliability and Control in Thermal Spray* - Sponsored by ASM Thermal Spray Society, email contact Kristin.Minihan@asminternational.org

7-10 Bangkok, Thailand *PMP-III 3rd Int'l Conference on Processing Materials for Porperties* - contact TMS tel: 724.776.9000, email: mtgserv@tms.org, web: www.tms.org

FEBRUARY 2009

15-18 New Orleans, LA USA PACE 2009 - contact Society for Protective Coatings, web www.pace2009.com

MAY 2009

3-6 Helsingør Denmark *15th Int'l Conference on the Joining of Materials* - contact: JOM tel: +45.48355458, email: jom_aws@post10.tele.dk

4-7 Las Vegas, NV USA *ITSC 2009 International Thermal Spray Conference & Expo* - contact ASM Int'l tel: 440.338.5151,web: www.asminternational.org, email: customerservice@asminternational.org

JUNE 2009

8-12 Orlando, FL USA *ASME Turbo Expo 2009* **-** Orlando World Marriott Resort **-** visit www.turboexpo.org

JULY 2009

12-17 Ottawa, Ontario Canada *12th Int'l Conference on Fracture (ICF12)* - visit www.icf12.com

SEPTEMBER 2009

14-19 Essen, Germany *International Trade Fair - Joining, Cutting, and Surfacing* - visit web: www.messe-essen.de, contact email: christina.kleinpass@messe-essen.de

CALENDAR OF EVENTS

OCTOBER 2009

19-20 Toronto,Ontario Canada *Canadian Manufacturing Technology Show 2009* - visit www.sme.org

NOVEMBER 2009

15-18 Chicago, IL USA *FABTECH Int'l & AWS Welding Show and Metalform*- ***with a Thermal Spray Pavilion*** - organized by American Welding Society, www.aws.org, Fabricators and Mfgrs Assoc, www.fmafabtech.com, Society of Manufacturing Engineers, www.sme.org/fabtech

NOVEMBER 2010

2-4 Atlanta, GA USA *FABTECH Int'l & AWS Welding Show and Metalform*- ***with a Thermal Spray Pavilion*** - organized by American Welding Society, www.aws.org, Fabricators and Mfgrs Assoc, www.fmafabtech.com, Society of Manufacturing Engineers, www.sme.org/fabtech

Calendar Highlight

Expanding Thermal Spray Performance to New Markets and Applications

Join us for the world's foremost international conference and exposition for thermal spray technologists, researchers, manufacturers and suppliers.

This annual event in the world of thermal spray technology is jointly organized by the German Welding Society (DVS), the ASM Thermal Spray Society (ASM TSS), and the International Institute of Welding (IIW)

Welcome to the 2009 International Thermal Spray Conference and Exposition. ITSC is the preeminent global thermal spray annual event. This 2009 event will be held May 4-7, 2009 at the Flamingo Las Vegas Hotel in Las Vegas, Nevada

Our international delegation of materials and design engineers, research scientists, manufacturers, suppliers and users will gather to exchange ideas on meeting the challenges and opportunities of the years to come. During ITSC 2009, you will experience three days of premier technical programming from the world's leading thermal spray experts, an unparalleled exposition featuring the world's largest gathering of thermal spray equipment suppliers, consumable and accessory suppliers, as well as vendors and service providers. In addition, enjoy unmatched educational programs and networking events.

For more information, visit www.asminternational.org/itsc

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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.

Journal of Thermal Spray Technology®

A publication of the *ASM Thermal Spray Society*

Abstract: Thermal Barrier Coatings Made by the Solution Precursor Plasma Spray Process

Maurice Gell, Eric H. Jordan, Matthew Teicholz, Baki M. Cetegen, Nitin P. Padture, Liangde Xie, Dianying Chen, Xinqing Ma, and Jeffrey Roth

The solution precursor plasma spray (SPPS) process is a relatively new and flexible thermal spray process that can produce a wide variety of novel materials, including some with superior properties. The SPPS process involves injecting atomized droplets of a precursor solution into the plasma. The properties of resultant deposits depend on the time-temperature history of the droplets in the plasma, ranging from ultra-fine splats to unmelted crystalline particles to unpyrolized particles. By controlling the volume fraction of these three different constituents, a variety of coatings can be produced, all with a nonograin size. In this article, we will be reviewing research related to thermal barrier coatings, emphasizing the processing conditions necessary to obtain a range of microstructures and associated properties. The SPPS process produces a unique strain-tolerant, low-thermal conductivity microstructure consisting of (i) three-dimentional micrometer and nonometer pores, (ii) through-coating thickness (vertical) cracks, (iii) ultra-fine splats, and (iv) inter-pass boundaries. Both thin (0.12 mm) and thick (4mm) coatings have been fabricated. The volume fraction of porosity can be varied from 10% to 40% while retaining the characteristic microsturcture of vertical cracks and ultra-fine splats. The mechanism of vertical crack formation will be described.

Read the entire article in the December 2007 *Journal of Thermal Spray Technology*.
For more information, visit
www.asminternational.org/tss
Editor: Christian Moreau
Associate Editors: Kendall Hollis, Seiji Kuroda, and Armelle Vardelle

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Send your letter to SPRAYTIME by e-mail to spraytime@thermalspray.org or via fax to 440.357.5430; electronic submissions as a Word document are preferred. Letters must be signed and must give the author's name, affiliation, and phone or e-mail address. The author's name will be published. Letters of fewer than 300 words will be given preference. Longer letters may be abridged by the editor. Please give the headline and issue number if referring to a specific article previously published.

The editor reserves the right to select letters for publication, and due to space and time limitations not all letters will be published nor acknowledged. If you have any questions please contact SPRAYTIME via email spraytime@thermalspray.org, or via phone 440.357.5400.

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PEOPLE IN THE NEWS

NanoSteel® Announces New Board Appointment Mark R. Baker

The NanoSteel® Company, a leader in the development and commercialization of nanostructured steel alloy surface technologies for industrial applications, announces the appointment of mining industry business leader ***Mark R. Baker*** to its board of directors.

"I am very pleased to welcome Mark Baker to NanoSteel's board of directors," says Dave Paratore, president and CEO. "Mark's outstanding reputation as a leading advisor in the mining industry and his extensive senior management experience and strategic business planning expertise will be very beneficial to our company. Since mining is an important market for NanoSteel, I look forward to Mark making significant contributions to the future development and market share growth of our portfolio of Super Hard Steel® coating solutions in this industry."

Baker is a former board member and senior executive of Komatsu America, Inc. While at Komatsu, Baker led the initial product development and worldwide strategic business planning for the introduction of the first commercial autonomous (driverless) haulage system in the mining industry. Before joining Komatsu, Baker was a co-founder of Modular Mining Systems, a mining management and control system software development company in Tucson, where he held various positions of increasing responsibility, including executive vice president and director. Prior to joining Modular Mining Systems, Baker held various engineering positions at Fairchild Semiconductor, National Semiconductor and Intel Corporation. Baker holds four US patents and received his BS in electrical engineering from the University of Arizona in 1978.

NanoSteel® Hires Michael Quinlan as Vice President, Sales and Marketing

The NanoSteel® Company, a leader in nanostructured steel alloy surface technologies for industrial applications, announces the addition of ***Michael Quinlan*** as vice president, sales and marketing. Quinlan will be based at NanoSteel's corporate headquarters in Providence, R.I. and lead all sales and marketing activities for the company's portfolio of Super Hard Steel® coating, overlay and wear plate solutions.

"Michael brings a wealth of business expertise to NanoSteel's senior management team," says Dave Paratore, president and CEO. "His executive leadership skills and sales and marketing experience will help NanoSteel strengthen relationships with its current customers and also develop new opportunities to grow our business."

Quinlan has more than 25 years of experience in nuclear, hydro and fossil power generation covering a wide range of roles including sales management, operations, regulatory compliance, project management and manufacturing. Quinlan arrives from Babcock Power Services in Massachusetts where he served as director of project proposals. Prior to this, Quinlan developed and managed Alstom Power's surface technology division in Chattanooga. Quinlan completed his focused business management program at Duke University's Fuqua School of Business.

The NanoSteel Company, Inc., headquartered in Providence, R.I., develops and markets patented Super Hard Steel nanostructured alloy coating and overlay solutions that effectively solve or alleviate many operational challenges faced in critical industries today, including wear, corrosion and erosion in a wide range of complex service environments.

For more information, email info@nanosteelco.com or visit www.nanosteelco.com

Your **employee should be listed here.**

Send information to spraytime@thermalspray.org

Stork Cellramic Appoints David Hart Technical Manager

Stork Cellramic of Milwaukee, Wisconsin, is pleased to announce the appointment of ***David Hart*** as the new Technical Manager.

Hart has worked internationally for over 25 years in the fields of engineering coatings and materials technology. His previous work includes positions with The NanoSteel Company, Wall Colmonoy Corporation, and Messer Eutectic Castolin, as well as other positions in technology and business development. Hart served as Technical Director/ Manager for Eutectic in the USA, Canada and Australia.

Hart holds a Master's Degree in Business Administration and a Degree (Hons) in Metallurgy and Materials. He is a member of the American Welding Society (AWS), a recent board member for the ASM Thermal Spray Society (TSS), and a judge of technical papers for the International Thermal Spray Conference (ITSC). Hart also serves on the Industry Advisory Board for the University of Wisconsin.

Stork Cellramic General Manager Daniel Ruiter said, "David brings a great deal of experience in the industries and technologies that are important to our customers. He is a proven trainer, mentor, and manager, and will be able to provide knowledgeable support to his Stork Cellramic colleagues as well as our client base. We are excited to welcome such a great technical expert in our business field to the team."

As Technical Manager, Hart will be responsible for the development of new technologies and applications. He will lead engineering and development work and will work closely with customers, sales and production. He began work in the Milwaukee facility on Tuesday, May 27.

Stork Cellramic, Inc., a member of the Stork Materials Group of companies, is a high-tech company specializing in the application and finishing of thermal spray coatings for industrial applications such as printing, converting, gas turbine, food processing and packaging. In addition, Stork Cellramic is a leading manufacturer of anilox rolls, and specializes in the resurfacing of worn anilox, idler and water rolls for the printing industry. Stork Cellramic also offers the application of engineered coatings for industrial components using plasma, HVOF, and arc spray processes.

Stork Materials Technology is a network of independent, accredited laboratories providing testing solutions to industry throughout the U.S. and Europe. Stork engineers, scientists, failure analysts, and product development and qualification experts support businesses with materials selection and engineering, materials testing, performance testing, failure analysis and consulting, nondestructive testing and inspection, calibration, construction materials testing and engineering, polymer and advanced materials testing, dimensional inspection, surface treatment, product qualification and development, and more.

For more information, contact David at david.hart@stork.com and visit the Stork Materials Technology website at www.storksmt.com

Huffman Corporation Announced John Grenier as Northeast Regional Sales Manager

Huffman Corporation announced today that it has added a key resource to their sales team to address the growth in the gas turbine manufacturing, aerospace engine and medical markets. ***John Grenier*** from East Windsor, CT has joined them as their Northeast Regional Sales Manager.

John Grenier will represent Huffman Corporation and Springfield Manufacturing LLC to their customer base in the Northeast territory starting May 12, 2008. His direct sales area will include CT, DC, DE, MA, ME, NH, NJ, NY, PA, RI, VT, and WV as well as Quebec, Canada. John brings a wealth of aerospace experience having spent 20 years with Pratt & Whitney including 5 years as Sales Manager and Regional Sales Manager for their Aftermarket parts and Jet Engine Parts Repair business. Recently he has worked with Belcan Industries assuring successful implementation of their new ACE Operating system as ACE/Continuous Improvement Manager.

Stan Pearson, Business Development and Global Sales Manager said, "John's knowledge of the aerospace industry, their parts, and local customers in the Northeast area will allow him to make quick start to an area that is very active right now."

Founded in 1961, Huffman Corporation provides manufacturing process technology to the flight, industrial gas turbine, and medical markets. The company's main products are multi-axis superabrasive grinding machine systems, laser powder fusion machine systems, and precision abrasive waterjet machine systems. Located in Clover, SC, a suburb of Charlotte, NC; Huffman is an ISO 9001:2000 and CE-approved supplier with global sales and service.

For more information, please visit www.huffmancorp.com

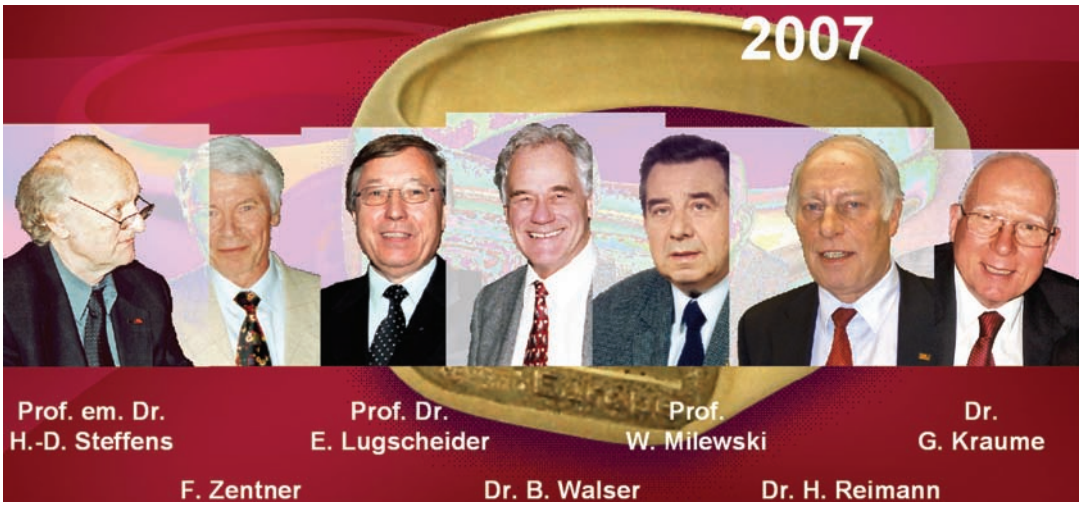
Albert Kay Receives the GTS Ring of Honor

Albert Kay; president of ASB Industries, Barberton, OH; was awarded the GTS (Association of Thermal Sprayers) Ring of Honor.

This award recognizes those people who have made a great contribution to thermal spraying and have committed themselves to the ideas of GTS. These ideas are: to set a high-quality standard for thermal spraying, to actively promote innovation, and to spread the thermal spray word and the GTS highlights of solidarity, sincerity and state-of-the-art.

The award was presented by Peter Heinrich, who, in his remarks stated "Albert Kay has given the GTS ideas his full support in the United States and also worldwide."

Al Kay was the first non-European to receive this prestegious award. Past GTS Ring of Honor recipients are shown below.



Rybicki Receives NACE Fellow Award

Edmund F. Rybicki, FASM, and the Harry H. Rogers Chair of Mechanical Engineering at The University of Tulsa, received the Fellow Award from the National Association for Corrosion Engineers (NACE, International) for his outstanding work in corrosion research.

Rybicki was presented the award at NACE's Corrosion 2007 annual conference that was held in Nashville, TN.

Pictured with Dr. Rybicki at the NACE Awards Banquet is David Webster (Right), president of NACE. From the 17,100 members of NACE, four were selected to receive the Fellow Award. In selecting Rybicki, NACE cited his long-term research on the effects of erosion and corrosion in oil field applications, his expertise on the effects of weld residual stresses on stress corrosion cracking for the electric power generating industry, and his knowledge of biomechanics of corrosion resistant orthopedic implants, where he is the lead inventor of a patent for a hip prosthesis stem.

Rybicki has received Fellow Awards from four different international engineering societies: the American Society of Mechanical Engineers, the American Welding Society, the American Society of Materials and NACE. He has co-authored 9 papers that have received awards. NASA has named a computer "Rybicki" in recognition of his contributions to fracture mechanics. In 2005, Rybicki received Oklahoma's Outstanding Professional Engineer of the Year Award.

Rybicki was chair of the ASM Thermal Spray Society Committee on "Accepted Practices for Evaluating Mechanical Properties of Thermal Spray Coatings" and co-authored two Accepted Practices on Mechanical Properties for ASM TSS. He also served two terms on the ASM Thermal Spray Society Board.

Professor Rybicki says, "These honors are the result of team efforts and I am fortunate to have worked with many outstanding colleagues while working at Battelle Columbus Labs and the University of Tulsa (TU). At TU, team members are Emeritus Professor John Shadley and Professors Siamack Shirazi, Brenton McLaury and Kenneth Roberts and Senior Technician, Edward Bowers." He also said, "Equally important is the continued support and interest provided, through the years, by my wife, Sandy and our 3 children."

For more information, contact Professor Rybicki, The University of Tulsa, 800 South Tucker Drive, Tulsa, OK 74104 USA, web: www.ecrc.utulsa.edu, tel: 918.631.2996, fax: 918.631.2397, e-mail: Ed-Rybicki@UTulsa.Edu

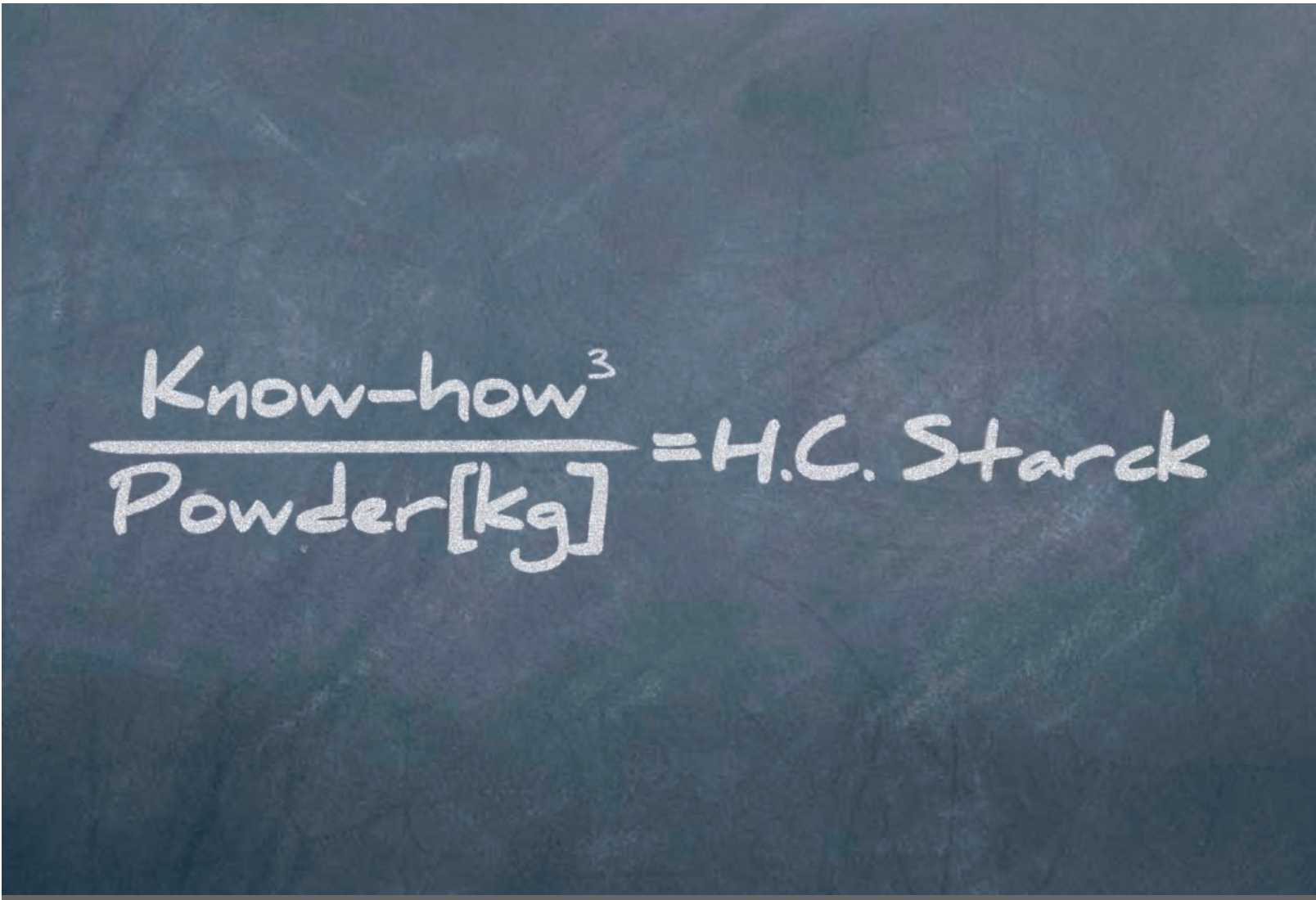
Knight Receives Drexel University Myers Award for Distinguished Service

Auxiliary professor ***Dr. Richard Knight***, FASM, immediate past president of the ASM Thermal Spray Society, is the 2007-2008 recipient of the Drexel University Harold M. Myers Award for Distinguished Service. This is the highest service award at Drexel presented to a faculty or staff member of the Drexel community who has gone above and beyond their position in service to the university community.

Dr. Knight was recognized by colleagues and students as an integral member of department, college, and university life in the area of service. He was particularly cited for his position as the Department of Materials Science and Engineering Chemical Hygiene Officer, his work in helping to transition the Centralized Research Facility from a departmental to a college and university facility, and his role as faculty advisor to student groups.

The award, consisting of a certificate of recognition and $2000, was presented at a Faculty Recognition Dinner on Wednesday, June 4, in Behrakis Grand Hall. Dr. Knight also was recognized at commencement on June 14th.

For more information, contact Dr. Richard Knight, Center for the Plasma Processing of Materials, Drexel University, Dept. of Materials Science & Engineering, 3141 Chestnut Street, Philadelphia, PA 19104 USA, tel: 215.895.1844, fax: 215.895.2332, e-mail: knightr@coe.drexel.edu, web: www.materials.drexel.edu



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