# THERMAL SPRAYING FOR POWER GENERATION COMPONENTS pdf

## 1: Power Generation | Global Tungsten & Powders Corp.

*Coatings constitute an intrinsic part of the power generation hardware. Thousands of patents, papers and conference presentations address new coating types, new hardware and software, new process developments, new chemical compositions.*

System overview[ edit ] A typical thermal spray system consists of the following: Spray torch or spray gun â€” the core device performing the melting and acceleration of the particles to be deposited Feeder â€” for supplying the powder , wire or liquid to the torch through tubes. Media supply â€” gases or liquids for the generation of the flame or plasma jet, gases for carrying the powder , etc. Robot â€” for manipulating the torch or the substrates to be coated Power supply â€” often standalone for the torch Control console s â€" either integrated or individual for all of the above Detonation thermal spraying process[ edit ] The detonation gun consists of a long water-cooled barrel with inlet valves for gases and powder. Oxygen and fuel acetylene most common are fed into the barrel along with a charge of powder. A spark is used to ignite the gas mixture, and the resulting detonation heats and accelerates the powder to supersonic velocity through the barrel. A pulse of nitrogen is used to purge the barrel after each detonation. This process is repeated many times a second. The high kinetic energy of the hot powder particles on impact with the substrate results in a buildup of a very dense and strong coating. Plasma spraying[ edit ] Wire flame spraying In plasma spraying process, the material to be deposited feedstock â€” typically as a powder , sometimes as a liquid , [2] suspension [3] or wire â€” is introduced into the plasma jet, emanating from a plasma torch. In the jet, where the temperature is on the order of 10, K, the material is melted and propelled towards a substrate. There, the molten droplets flatten, rapidly solidify and form a deposit. Commonly, the deposits remain adherent to the substrate as coatings; free-standing parts can also be produced by removing the substrate. There are a large number of technological parameters that influence the interaction of the particles with the plasma jet and the substrate and therefore the deposit properties. These parameters include feedstock type, plasma gas composition and flow rate, energy input, torch offset distance, substrate cooling, etc. As the feedstock powders typically have sizes from micrometers to above micrometers, the lamellae have thickness in the micrometer range and lateral dimension from several to hundreds of micrometers. Between these lamellae, there are small voids, such as pores, cracks and regions of incomplete bonding. As a result of this unique structure, the deposits can have properties significantly different from bulk materials. These are generally mechanical properties, such as lower strength and modulus , higher strain tolerance, and lower thermal and electrical conductivity. Also, due to the rapid solidification , metastable phases can be present in the deposits. Applications[ edit ] This technique is mostly used to produce coatings on structural materials. Such coatings provide protection against high temperatures for example thermal barrier coatings for exhaust heat management , corrosion , erosion , wear ; they can also change the appearance, electrical or tribological properties of the surface, replace worn material, etc. When sprayed on substrates of various shapes and removed, free-standing parts in the form of plates, tubes, shells, etc. It can also be used for powder processing spheroidization, homogenization, modification of chemistry, etc. In this case, the substrate for deposition is absent and the particles solidify during flight or in a controlled environment e. This technique with variation may also be used to create porous structures, suitable for bone ingrowth, as a coating for medical implants. A polymer dispersion aerosol can be injected into the plasma discharge in order to create a grafting of this polymer on to a substrate surface. Plasma spraying systems can be categorized by several criteria. This surface engineering can improve properties such as frictional behavior, heat resistance , surface electrical conductivity , lubricity , cohesive strength of films, or dielectric constant , or it can make materials hydrophilic or hydrophobic. It can induce non-thermally activated surface reactions, causing surface changes which cannot occur with molecular chemistries at atmospheric pressure. Plasma processing is done in a controlled environment inside a sealed chamber at a medium vacuum, around 13â€"65 Pa. The gas or mixture of gases is energized by an electrical field from DC to microwave frequencies, typically 1â€" W at 50 V. The treated components are usually electrically isolated. The volatile plasma by-products are evacuated from the chamber by the vacuum pump , and if necessary can be neutralized in an exhaust scrubber. In contrast to molecular chemistry, plasmas employ: Molecular, atomic, metastable and free radical species for chemical effects. Positive ions and electrons for kinetic effects. This can cause chain scissions and cross-linking. Plasmas affect materials at an atomic level. Techniques like X-ray photoelectron spectroscopy and scanning electron microscopy are used for surface analysis to identify the processes required and to judge their effects. As a simple indication of surface energy , and hence adhesion or wettability, often a water droplet contact angle test is used. The lower the contact angle, the higher the surface energy and more hydrophilic the material is. Changing effects with plasma[ edit ] At higher energies ionization tends to occur more than chemical dissociations. In a typical reactive gas, 1 in molecules form free radicals whereas only 1 in ionizes. The predominant effect here is the forming of free radicals. Ionic effects can predominate with selection of process parameters and if necessary the use of noble gases. Wire arc spray[ edit ] Wire arc spray is a form of thermal spraying where two consumable metal wires are fed independently into the spray gun. These wires are then charged and an arc is generated between them. The heat from this arc melts the incoming wire, which is then entrained in an air jet from the gun. This entrained molten feedstock is then deposited onto a substrate with the help of compressed air. This process is commonly used for metallic, heavy coatings. Plasma transferred wire arc Plasma transferred wire arc PTWA is another form of wire arc spray which deposits a coating on the internal surface of a cylinder, or on the external surface of a part of any geometry. It is predominantly known for its use in coating the cylinder bores of an engine, enabling the use of Aluminum engine blocks without the need for heavy cast iron sleeves. A single conductive wire is used as "feedstock" for the system. A supersonic plasma jet melts the wire, atomizes it and propels it onto the substrate. The plasma jet is formed by a transferred arc between a non-consumable cathode and the type of a wire. After atomization, forced air transports the stream of molten droplets onto the bore wall. The particles flatten when they impinge on the surface of the substrate, due to the high kinetic energy. The particles rapidly solidify upon contact. The stacked particles make up a high wear resistant coating. The PTWA thermal spray process utilizes a single wire as the feedstock material. All conductive wires up to and including 0. PTWA can be used to apply a coating to the wear surface of engine or transmission components to replace a bushing or bearing. For example, using PTWA to coat the bearing surface of a connecting rod offers a number of benefits including reductions in weight, cost, friction potential, and stress in the connecting rod. High velocity oxygen fuel spraying HVOF [ edit ] During the s, a class of thermal spray processes called high velocity oxy-fuel spraying was developed. A mixture of gaseous or liquid fuel and oxygen is fed into a combustion chamber , where they are ignited and combusted continuously. The resultant hot gas at a pressure close to 1 MPa emanates through a convergingâ€”diverging nozzle and travels through a straight section. The fuels can be gases hydrogen , methane , propane , propylene , acetylene , natural gas , etc. The stream of hot gas and powder is directed towards the surface to be coated. The powder partially melts in the stream, and deposits upon the substrate. The resulting coating has low porosity and high bond strength. It is typically used to deposit wear and corrosion resistant coatings on materials, such as ceramic and metallic layers. The process has been most successful for depositing cermet materials WCâ€”Co, etc. The method was originally developed in Russia, with the accidental observation of the rapid formation of coatings. This occurred while experimenting with particle erosion of a target exposed to a high velocity flow loaded with fine powder in a wind tunnel. In cold spraying, particles are accelerated to very high speeds by the carrier gas forced through a convergingâ€”diverging de Laval type nozzle. Upon impact, solid particles with sufficient kinetic energy deform plastically and bond mechanically to the substrate to form a coating. Metals , polymers , ceramics , composite materials and nanocrystalline powders can be deposited using cold spraying. It is possible to accelerate powder particles to much higher velocity using a processing gas having high speed of sound helium instead of nitrogen. However, helium is costly and its flow rate, and thus consumption, is higher. To improve acceleration capability, nitrogen gas is heated up to about C. As a result, deposition efficiency and tensile strength of deposits increase. The resulting gas contains much water vapor, unreacted hydrocarbons and oxygen, and thus is dirtier than the cold spraying. However, the coating efficiency is higher. On the other hand, lower temperatures of warm spraying reduce melting and chemical reactions of the feed powder, as compared to HVOF. These advantages are especially important for such coating materials as Ti, plastics, and metallic glasses, which rapidly oxidize or deteriorate at high temperatures.

## 2: Components Materials and Equipment

*Considering all advantages and disadvantages thermal spraying offers often the best solution for power-generation components. This statement applies for new components as well as for overhaul. All thermal-spraying processes applied in air can be used on site as well.*

## 3: Erosion Resistant Coating | A&A Thermal Spray Coatings

*Klaus Schneider is a Consultant in materials, manufacturing and logistics for the power generation industry, after being in charge of research projects at ALSTOM, Switzerland. He has more than 30 years of experience in this business.*

## 4: Power Generation Â« Oerlikon Metco

*To understand the capability and limitations of thermal spraying, to understand deposition efficiency (waste of powder) and the importance of maintenance and spare parts for quick change over of worn equipment, to use offline programming and real equipment in an optimum mix to end up with stable processes in production after shortest.*

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## 6: Gas Turbine Thermal Barrier Coating in Combustion Liners | CTS

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## 7: Welcome to AMT AG | AMT AG Switzerland

*Note: Citations are based on reference standards. However, formatting rules can vary widely between applications and fields of interest or study. The specific requirements or preferences of your reviewing publisher, classroom teacher, institution or organization should be applied.*

## 8: Thermal spraying - Wikipedia

*Thousands of patents address new coating types, new developments, new chemical compositions. However, sometimes coatings is still considered as an "art". This book now deals with questions that are essential for a good performance of this "art": I.*

## 9: Thermal Spray Coating Shop for Power Plants in Mumbai

*Thermal Spraying for Power Generation Components. Belashchenko, V., Dratwinski, M., Siegmann, S. and Zagorski, A. () Offline Simulation of a Thermal-Spray.*

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