http://www.ofic.co.jp/en/

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Thermal Spraying

A SURFACE COATING TECHNIQUE

Items

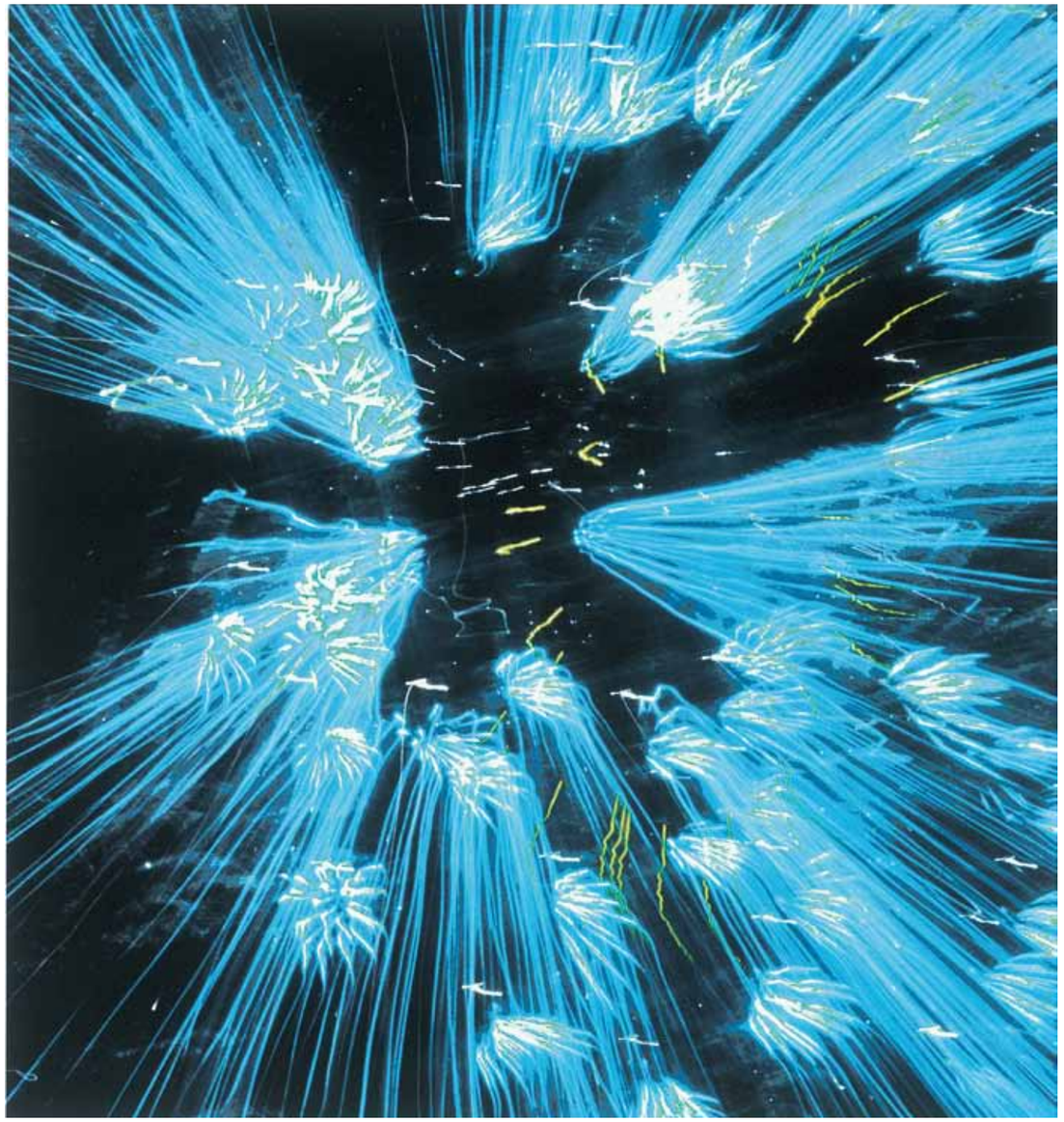
Water plasma spraying

Gas plasma spraying

High velocity oxygen fuel spraying

Electric arc spraying

Flame spraying(wire,rod,powder)



OSAKA FUJI Corporation

Thermal Spraying

Our thermal spraying technology utilized in a wide range of industrial fields

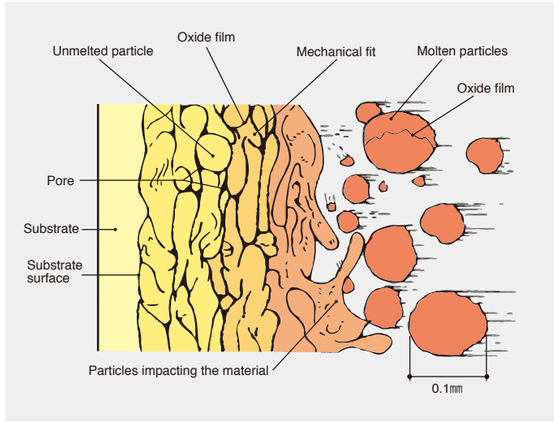
Thermal spraying is a technology that uses a combustion flame or electrical energy to fuse various types of materials, forming a coating on the surface of the substrates, and adding a high-quality, high-performance surface covering for a variety of equipment and devices. Thermal spraying is versatile, with application possible on substrates in a wide variety of types and shapes, where coating thickness can be specified from thin films to thick overlays. This technology is heavily used in all types of industrial fields for upgrading and diversification, as well as improving substrates performance, and development of substrates with new functions.

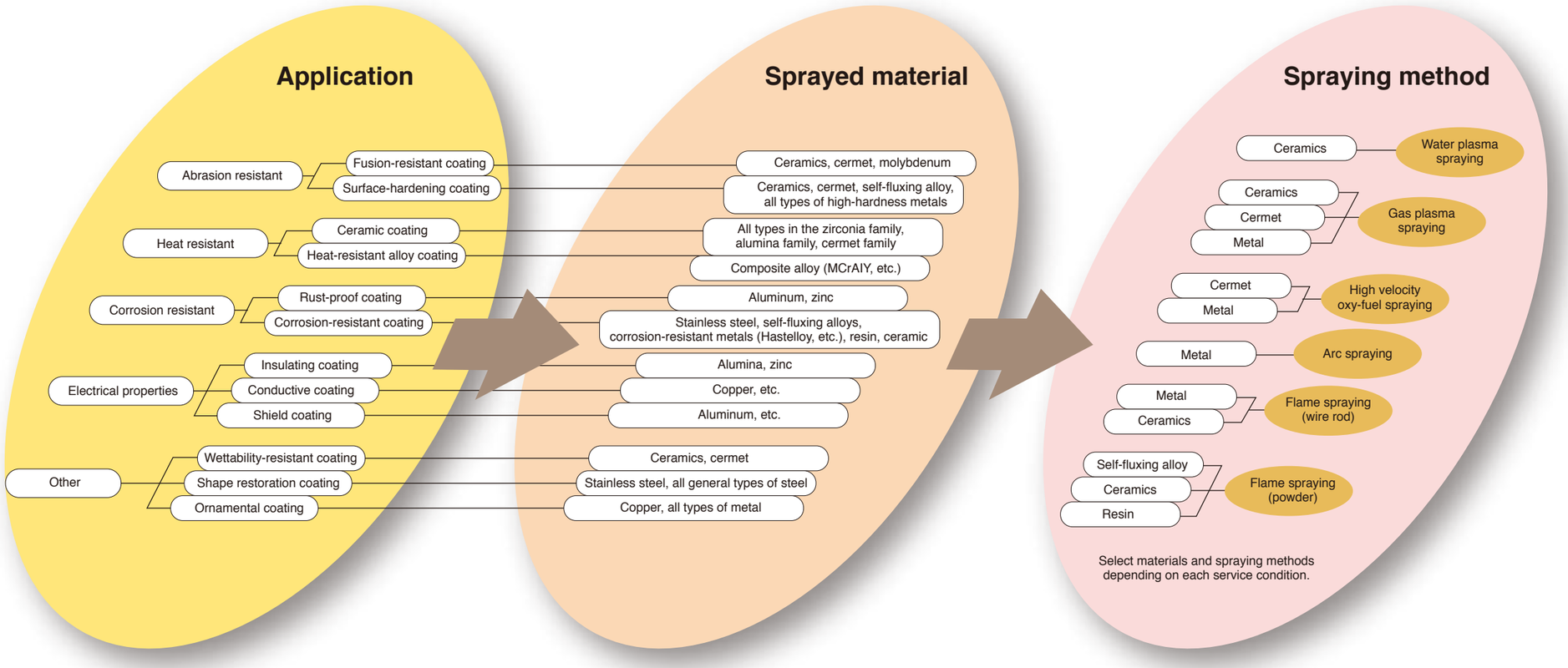
OFIC (OSAKA FUJI Corporation) offers optimal thermal spraying methods developed through many years of experience in thermal spraying technology, including selection of thermal spraying materials, methods, and spraying substrates, while considering every angle, such as application and required functionality. To become a leading company in the field of thermal spray technology, OFIC also actively participates in projects and technological development such as automation using robots, and the state-of-the-art metal thermal spraying, such as plasma thermal spray equipment for use at local sites.

Features of thermal spray technology

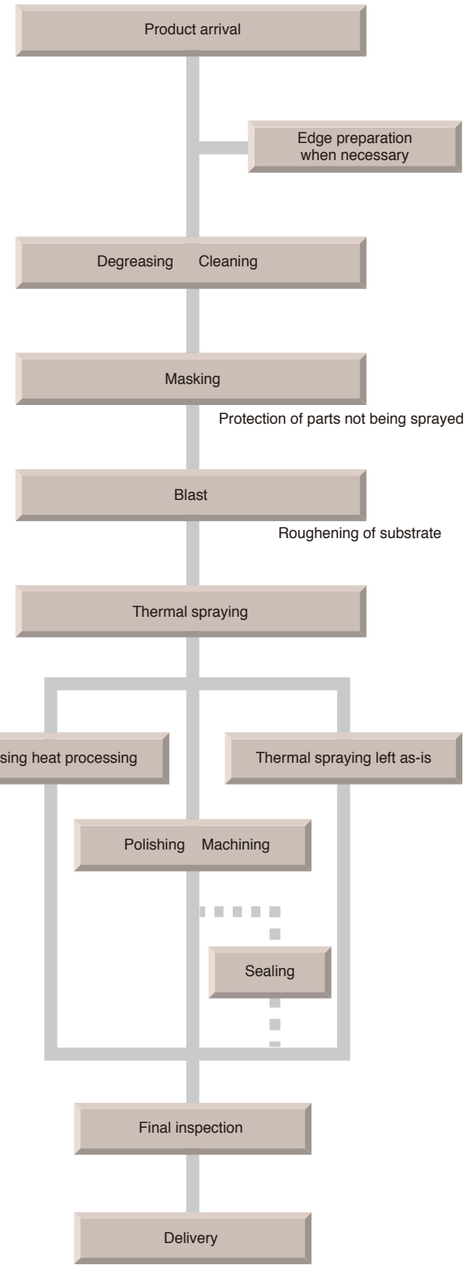
Thermal spray technology has various superior features when compared to other surface covering technologies.

- Various materials can be used in surface modification covering (thermal spraying materials) depending on the purpose of modification and application, such as fusible alumina, ceramics such as zirconia, as well as metals and plastics.
- Modification is possible even for large and complex-shaped equipment, down to small parts. Additionally, a wide-variety of coating thicknesses can be selected, from thin films to thick overlays.
- The thermal spray substrate remains comparatively low temperature (200°C or lower, approx.) during spraying, which allows the subject to maintain its organizational structure and physical properties.
- Thermal spraying can be carried out in atmospheric conditions, low-vacuum, or inert gas environments depending on the modification purpose or intended application.

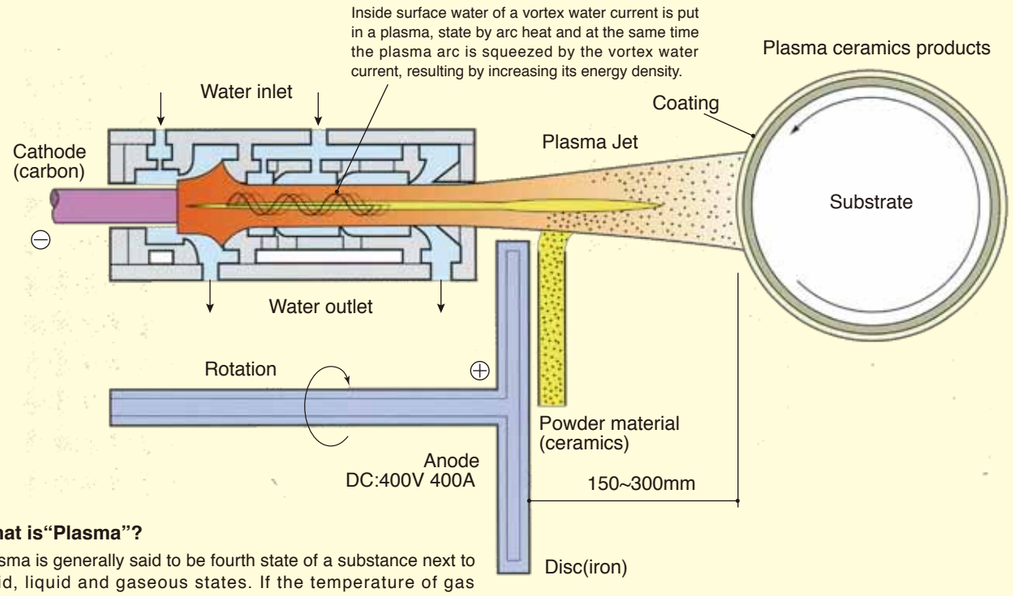




Thermal spraying application process



Water plasma spraying



What is"Plasma"?

Plasma is generally said to be fourth state of a substance next to solid, liquid and gaseous states. If the temperature of gas increases beyond its critical temperature, gaseous molecules dissociate into atoms and further electrons are repelled out of atoms to ionize, resultingly producing a state in which molecules, atoms, (+) ions and (-)electrons exist together. Such a mass of ionized high temperature gases is called Plasma.

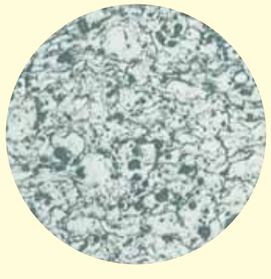
The mechanism of this apparatus is devised for a high pressure water current fed into a torch to produce a cylindrical vortex water current. Voltage applied across the carbon cathode and the iron-made rotating anode to forcibly generate a D.C. arc causes the inside surface water of the vortex water decomposition, continuously generating a plasma arc. Being squeezed by the turning cylindrical cater current and increasing its energy density, the plasma arc blows out as a high temperature and high speed stable plasma jet flare affected by the rapid thermal expansion of the plasma. The plasma jet flare, the highest temperature of which reaches as high as about 30,000°C enable to easily spray even ceramics with a high melting point.

■General characteristics

- A very high spraying capacity per unit time as high as 50kg at its maximum.
- Thick overlay of a sprayed film about 20mm possible. Control of a low substrate temperature at 200℃ or below during the prosecution of work possible.
- Most suitable for a mass and thick overlay spraying of a large member.
- A cheap spraying cost.

■Characteristics of OFIC

- OFIC enables to increase coating thickness limit to 20~50mm from 20mm which has so far been its limit.
- OFIC enable to spray even a metal type compound as a material which has so far been limited to oxide type ceramics.

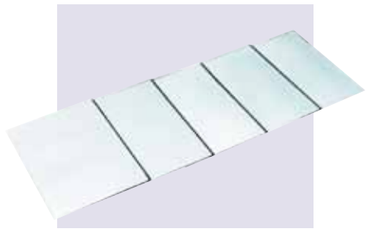


Spraying material :
Alumina Zirconia (50 magnifications)

Products

Water plasma spraying – perfect for large-format, thick covering applications

Ceramics spraying can reduce costs compared to gas plasma spraying!

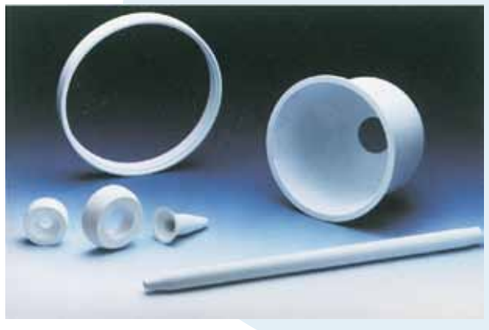


- Product: Carbon plating
- Application: Preventing reaction under high temperatures
- Size: 300 x 420 x 6 t

- Product: Conveyor pulley
- Application: Abrasion resistance, corrosion resistance
- Size: ϕ800 x 1500 l

- Product: Paper manufacturing roll
- Application: Abrasion resistance
- Size: ϕ800 x 6400 l

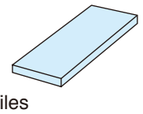
Newly-developed free ceramic molds



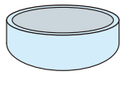
■ WAPLOC form and dimensions

Ceramic parts in various shapes can be fabricated.

Pipes
Maximum diameter of 2,000 ㎜
Maximum length of 7,500 ㎜



Tiles
Corners up to a maximum of 570 ㎜
Maximum length of 3,500 ㎜



Crucibles
Maximum of ϕ1,500 ㎜ for the sphere or flat bottom surface

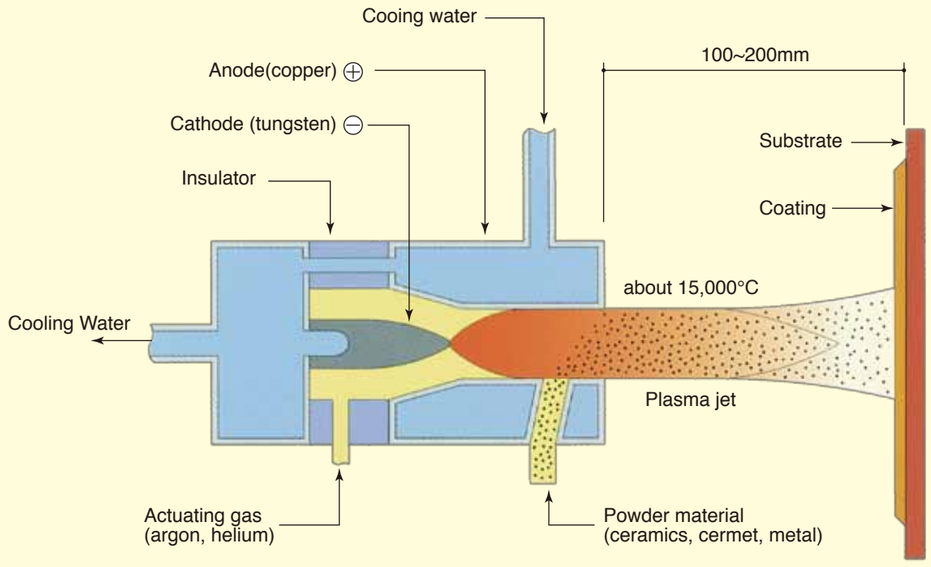
* The maximum thickness for WAPLOC products is 40 ㎜. However, there is a reasonable range depending on application and shape. Other specialized shapes can also be fabricated.

■ WAPLOC ceramic material

Dedicated purified materials are used for WAPLOC water plasma spraying.

Material	Chemical symbol	Melting point (°C)
Alumina	Al_2O_3	2,050
Spinel	$MgO \cdot Al_2O_3$	2,100
Alumina/Titania	$Al_2O_3 \cdot TiO_2$	1,860
Mullite	$3Al_2O_3 \cdot 2SiO_2$	1,850
Zircon	$ZrO_2 \cdot SiO_2$	1,700

Gas plasma spraying



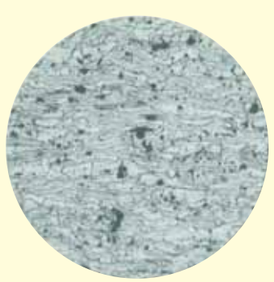
It voltage is applied across the tungsten cathode and the copper nozzle anode in the actuating gas such as argon and helium to generate a D.C. arc, the actuating gas dissociates and ionizes, continuously generating a plasma arc. This plasma arc is squeezed by the nozzle and blows out as a plasma jet of an ultrahigh temperature at 15,000°C or above and of an ultrahigh speed.
Powders fed into the plasma jet are accelerated as being melted and coats a material. This method enables spraying of high melting point materials such as ceramics.
Further it enables formation of sprayed films of quality more superior compared with those obtained by other spraying methods because melted particles are sprayed to substrate at a high speed by Plasma jet. It can also spray various materials.

■General characteristics

- Spraying of all materials including ceramics and general metals possible.
- Formation of sprayed films finer and superior in quality effective heat resistance and chemical corrosion resistance.
- Rare oxidation and deterioration of materials because of the use of an inert gas such as argon.
- Control of low substrate temperature at 200℃ or below possible.
- Most suitable for spraying of a small member.

■Characteristics of OFIC

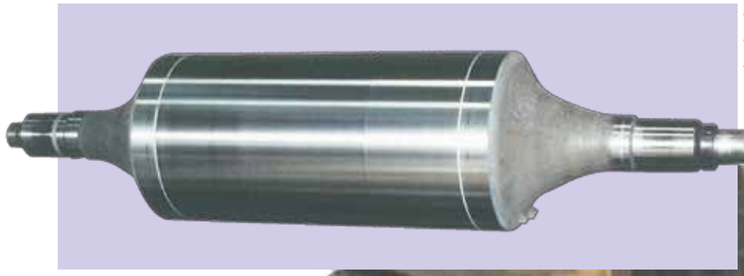
- A portable device enables on-the-spot plasma spraying.
- Spraying of a large construction(building) also possible.



Spraying material :
Almina Zirconia (50 magnifications)

Products

Gas plasma thermal spraying for high-tech coatings



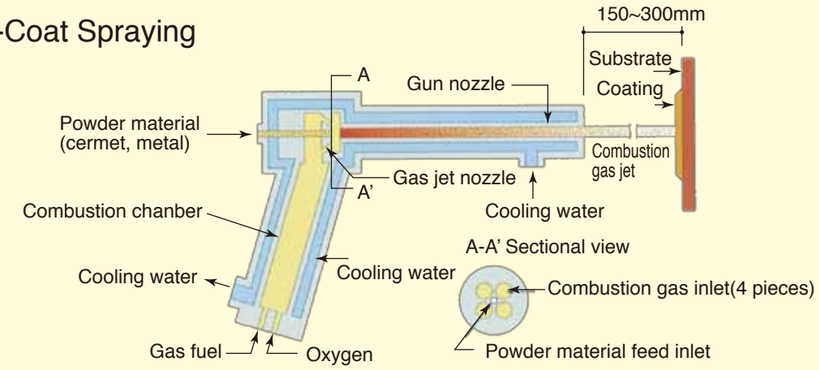
- Product: Hearth roll
- Application: Build-up resistance
- Size: ϕ800 x 2100l

- Product: Threading-resistant feed roller
- Application: Abrasion resistance
- Size: ϕ30 x 125 l

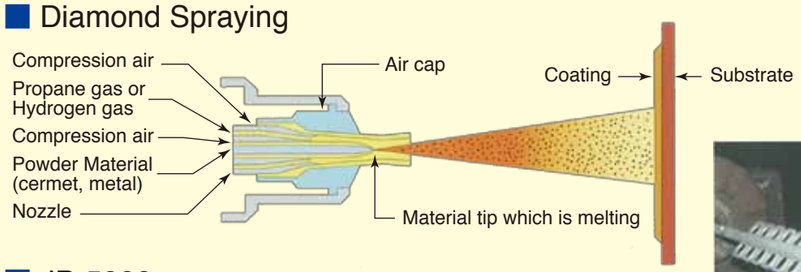
- Product: Walking beam
- Application: Build-up resistance
- Size: 210 x 250 x 2800

High velocity oxy-fuel spraying

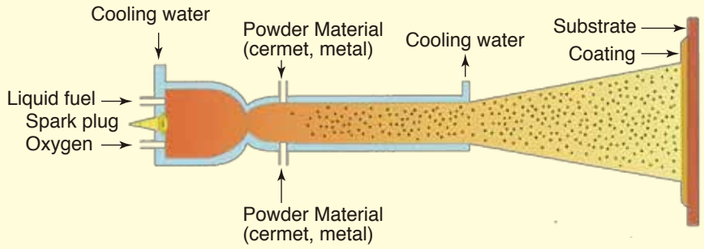
Jet-Coat Spraying



Diamond Spraying



JP-5000



Hydrocarbon and hydrogen-mixed gas is burned in the internal combustion chamber and the combustion gas is converted into a high temperature ultrasonic combustion gas jet(Mach 5 or more) through four concentrated nozzles.
A powder material fed into the center of the gas jet by nitrogen gas crashes against a substrate as being melted and accelerated inside the nozzle and in the highly concentrated combustion gas jet.
Consequently, coatings fine and superior in quality can be formed.

Spraying material :
tungsten carbide cobalt (200 magnifications)

■General characteristics

- Formation of coatings superior in quality which are better in their hardness and fineness and more adhesive compared with those obtained by other spraying methods.
- Most suitable for spraying of refractory metal materials(WC-Co).
- Highly efficient in spraying because of its long and highly concentrated gas jet.
- Most suitable for spraying of small members because of its gas jet with a smaller diameter.
- Control of a raw material temperature at 200℃ or below possible.
- Small and uniform roughness of a coating surface.

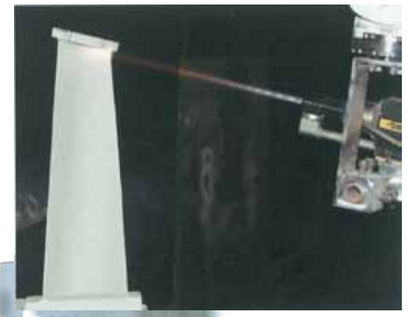
■Characteristics of OFIC

- Spraying of cermet such as chromium carbide type materials possible.
- Spraying of a large member also possible.
- Control of coating properties by changing the kind of gas possible.

Products

Super high-precision coating high velocity oxy-fuel spraying

- Product: Turbine blade
- Application: High-temperature oxidation resistance



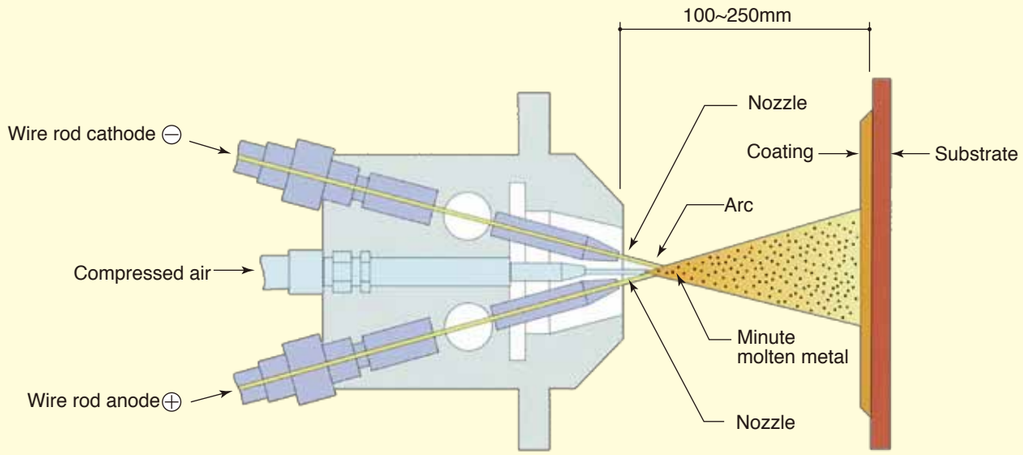
- Product: Bridle roll
- Application: Anti-slip
- Size: ϕ1500 x 2100 l

- Product: Paper manufacturing roll
- Application: Abrasion resistance
- Size: ϕ500 x 6500 l

- Product: Ultrasonic horn
- Application: Abrasion resistance
- Size: 50 x 50 x 150, etc.

JP-5000: Co-based self-fluxing alloy x 50
Vacuum heat treatment

Arc spraying



- Piston : Φ230×1500l

Two pieces of spraying materials (wire rod) continuously fed, which are + and - electrodes, respectively, generate arcs at their tips. Molten drops of metals melted by the arc heat are continuously made minute by the air jet and are sprayed on the surface of a substrate.

■General characteristics

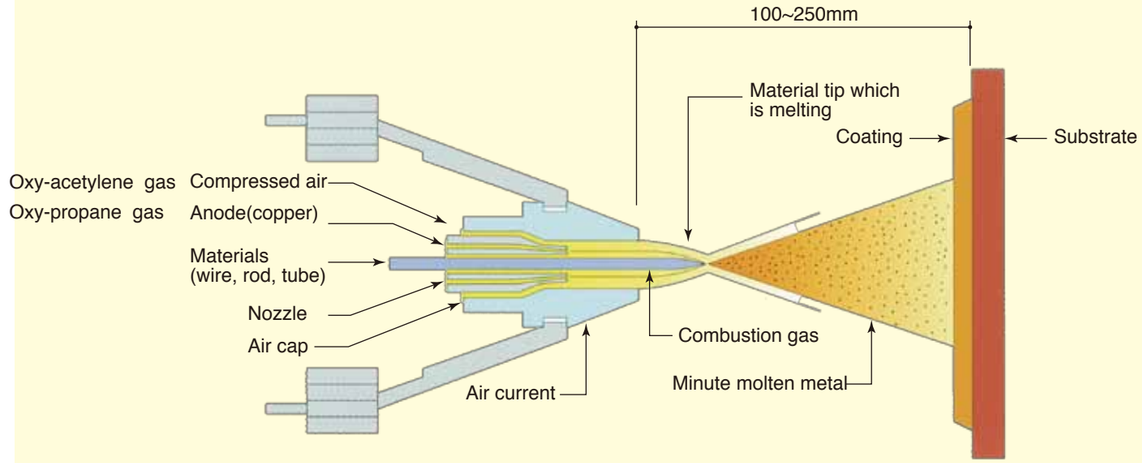
- Adhesive strength and bond strength greater than those with flame spraying.
- High spraying efficiency
- Formation of a quasi alloy coating by using two pieces of dissimilar metal and alloy wire rods.
- Spraying by all metals which can be wire rods possible.
- No deterioration and changes found on materials to be sprayed because of low temperature spraying.
- Superior oil retaining property and very improved sliding wear characteristic because of pores within coatings.

■Characteristics of OFIC

- Attainment of thick overlay spraying as thick as 20mm.
- On-the-spot spraying possible.

Spraying material :
SUS410(13% Cr stainless steel / 200 magnifications)

Flame spraying (wire, rod)



The wirelike or rodlike spraying material inserted through the center hole of the spraying torch is melted by Oxygen-fuel flare. Then being made minute and blown away by compressed air jet from the circumference, it is sprayed on the surface of substrate.

■General characteristics

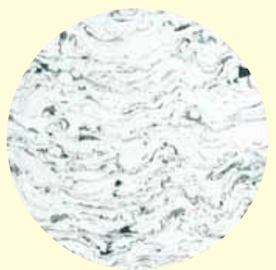
- No deterioration and changes found on materials to be sprayed because of the low temperature spraying.
- Spraying of ceramics with a comparatively low melting point possible according to the shape of rods or tubes.
- Coatings with finer surface roughness and higher hardness obtained with arc spraying.
- Smaller loss of chrome and carbon compared with arc spraying.

■Characteristics of OFIC

- OFIC has many achievements of rust preventive spraying for aluminum and zinc as the main force of on-the-spot spraying.

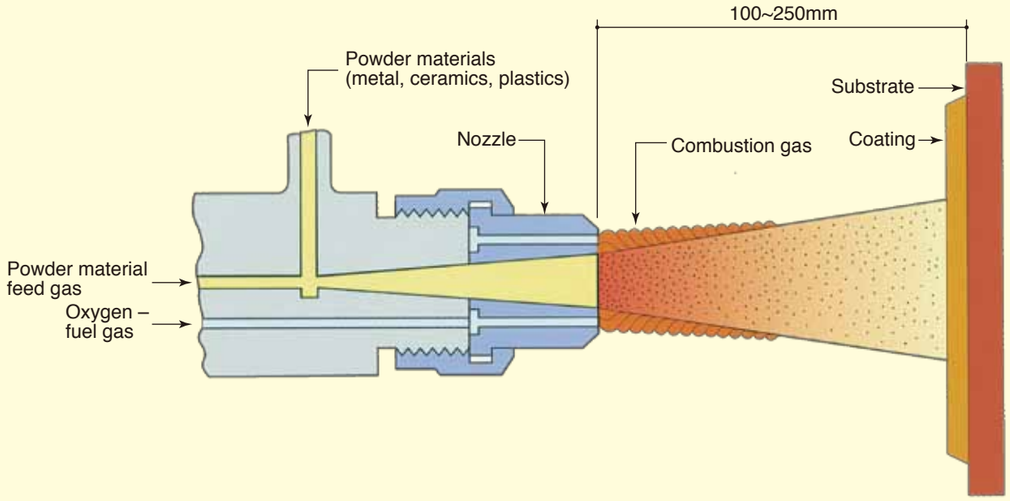
- Backup roll chuck ：
size：1700×1100×2700(38ton)

- Induction heating pot :
sizeΦ550×250 H



Spraying material :
SUS410(13% Cr stainless steel /100 magnifications)

Flame spraying (Powder)

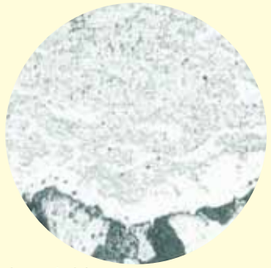


The spraying powder material fed into the spraying torch by feed gas through the feed inlet is melted by oxygen-fuel flare and sprayed on the surface of substrate.
This spraying method is used especially for spraying a fluxing alloy. It can also spray ceramics and plastics ※1 as well as general metals.

● Self-fluxing alloy spraying
A pore-less deposit metal layer is formed by applying a refusing process ※2 after the spraying of the self-fluxing alloy powder material according to the above-mentioned gas powder spraying method.

■General characteristics
- A low friction coefficient and high wear resistance.
- Corrosion resistance higher than that of the equivalent to high nickel alloys.
- High hardness at high temperatures.
- Does not need a thick padding and gives uniform hardness because of its deposit filling without penetration of a substrate which appears in build up welding.
- Brings added values such as high wear resistance by dispersing carbides and boride.

■Characteristics of OFIC
- OFIC enables spraying of even substrate such as cast iron for which a welding method is not suitable.
- On-the-spot spraying possible.
- Spraying of large members also possible.



Spraying material :
self-fluxing nickel alloy (refusing process, 200 magnifications)

※1 Nylon 11, polyethylene, epoxy resin and denatured EVA can be used as plastic spraying materials.

※2 Refusing process is to combine the sprayed coating with the substrate metallurgically by putting the coating in a semi-molten state at 1,000~1,100°C. Boron and silicon in the alloy reduces in the coating and they change to stays which rise to the surface, consequently making the structure of the coating pore-less. At that time boron and carbon in the alloy precipitate as boride and carbide, resultingly improving the wear resistance.

Products

Flame spraying (powder) – perfect for self-fluxing alloys

- Product: Plunger
- Application: Abrasion resistance
- Size: ϕ125 x 450 l

- Product: Sleeve
- Application: Abrasion resistance
- Size: ϕ70 x 50 l, etc.

- Product: V roll
- Application: Abrasion resistance/seizure resistance
- Size: ϕ200 x 185 l

Main thermal spraying materials and coating properties - 1

* indicates that no air passes through pores.
( ) indicates values of the original material data.

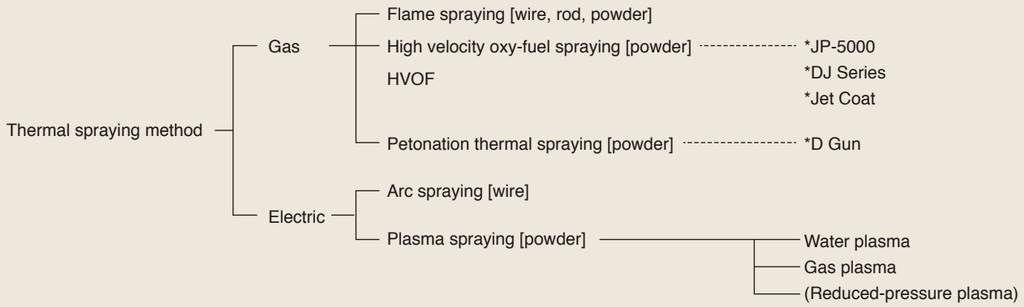
◎ : Optimal ○ : Suitable

Classification		Material name	Typical composition	Thermal spraying method: Gas: Flame (wire, rod)	Gas: Flame (powder)	Gas: HVOF	Electrical: Arc (wire)	Electrical: Gas plasma	Electrical: Water plasma	Abrasion resistance	Heat resistance	Corrosion resistance	Applicable conditions /features	Hardness	Bond strength MPa	Porosity Vol. %	pecific gravity g/cm³	Thermal expansion coefficient x 10-6/℃	Thermal conductivity Cal/cm·sec/℃	Electrical resistance μΩ·cm
Metals/alloys	Metals with a low melting point	Zinc	99.9-Zn	◎			○					○	Rustproof PH6 – 12	HRh46	5~10	2~5	6.36	(39.7)	(0.27)	(6)
		Aluminum	99.7-Al	◎			○	○				○	Rustproof PH4 – 8	HRh80	10~20	2~5	2.41	(23.9)	0.19	(2.9)
		Zinc-aluminum alloy	Zn-15Al	◎			○					○	Rustproof	HRh80U~	10~20	2~5				
	Carbon steel	Low-carbon steel (mild steel)	Low C	◎			◎			○			IH coating, thick maintenance coating	Hv150	20~30	2~5	6.36			
		High-carbon steel (piano wire)	0.8C	◎						◎			Hardened thick maintenance coating	Hv360	20~30	2~5	6.36	(11.7)	0.080	(23)
	Stainless steel	SUS-420J2 martensite family	13Cr-0.4C	◎			◎	◎		◎			Harder than SUS410	Hv350	30~50	2~5	6.78	(9.2)	(0.0596)	(56)
		SUS-430 ferrite family	18Cr-0.1C	◎			◎	◎		○			Softer than SUS410	Hv250	30~50	2~5	6.78	(9.2)	(0.058)	
		SUS-316 austenite family	18Cr-12Ni-2.5Mo-0.6C	◎		○	◎	◎				○	Non-magnetic, highly corrosion resistant	Hv240	30~50	2~5	6.93			
		Fe-Cr family of amorphous alloy	Fe-28Cr-3.7B-2Mn-1.7Si, etc.			○	◎			◎			Abrasion resistant to dust	Hv900		2~5				
	Copper alloy	Pure copper	99.8-Cu	◎		○	◎	◎					Conductive line covering	Hv70	20~30	2~5	7.2	(16.5)	0.34	(2.6)
		Brass	66Cu-36Zn	◎			◎	○					Highly modifiable		20~30	2~5				
		Aluminum bronze	90Cu-9Al-1Fe	◎			◎			○			Highly resistant to seizure	Hv150	20~30	2~5	7.06	(18.5)	0.075	(10)
	Heat-resistant alloy Corrosion-resistant alloy	Nickel aluminum	Ni-5Al	◎			◎	◎			○		Undercoating material	Hv120	50~60	2~5	7.4	(14.9)		
		Nickel chrome 80-20	80Ni-20Cr	◎			◎	◎			◎	○	High-temperature oxidation resistant	Hv200	40~50	2~5	7.1	(16.3)	(0.036)	(98)
		Nickel chrome 50-50	50Ni-50Cr	◎			◎	◎			◎	◎	High-temperature corrosion resistant	Hv300	40~50	2~5				
		Hastelloy B	Ni-Cr-Mo-W-Fe	◎			◎					◎	Hydrochloric acid resistant		40~50	2~5				
		Hastelloy C-276	Ni-15Cr-16Mo-4W-5.5Fe	◎		○	○	◎			○	◎	Acid resistant (all types of acids)	Hv350	40~50	2~5	(8.94)	(11.3)	(0.030)	(133)
		Inconel-625	Ni-21.5Cr-9Mo-2.5Fe-3.7(Nb+Ta)	◎		○	○				○	◎	Chloride corrosion resistant	Hv340		2~5				
		Monel	67Ni-30Cu-2Fe	◎			○					○	Salt water corrosion resistant	Hv140		2~5	6.67	(14.0)	(0.062)	(49)
		Stellite #6	Co-28Cr-4W-1C-3Fe			○		◎		○	○	○		Hv400						
		Tribaloy T-800	Co-28Mo-17Cr-3Si			○		◎		○	◎		High-temperature lubricity	Hv700~800						
	Metals with a high melting point	Molybdenum	99.5Mo	◎				◎		○			Highly seizure resistant	Hv400	40~50		8.86	(4.9)	(0.35)	(5.2)
		Tungsten	99.5W					◎					Molten Cu, Zn resistant							
	MCrAlY alloy	CoNiCrAlY	Co-32Ni-21Cr-8Al-0.5Y			○		◎			◎		High-temperature oxidation corrosion resistant	Hv400						
		NiCrAlY	Ni-22Cr-10Al-1Y			○		◎			◎		High-temperature oxidation corrosion resistant	Hv400						
Self-fluxing alloys	Ni-based	METCO 16C equivalent (4 types)	Ni-16Cr-4Si-4B-3Cu-3Mo-2.5Fe-0.75C		◎	○				◎	○	○	High bond strength, can be applied thickly	HRc60	300 or more	0*	7.53	14.4~16.2		
		METCO 15E equivalent (5 types)	Ni-17Cr-4Fe-4Si-3.5B-0.9C		◎	○				◎	○	○	High bond strength	HRc62	300 or more	0*				
	Co-based	METCO 18C equivalent (1 type)	Co-27Ni-18Cr-6Mo-3.5Si-3B-2.5Fe-0.2C		◎	○				◎	○	○	High tensile strength due to Ni base	HRc60	300 or more	0*				
		Stellite SF20 equivalent (2 types)	Co-13Ni-19Cr-15W-3S i-3B-4Fe-1.3C		◎	○				◎	○	○	Highly molten Zn - resistant	HRc60	300 or more	0*	7.90			
	Ni-based + WC	METCO 31C equivalent (2 types)	Ni-11Cr-2.5Fe-2.5Si-2.5B-0.5C+35WC		◎	○				◎			Excellent abrasion-resistance including WC	HRc60~75	300 or more	0*	8.30			
Cermet	Carbide family	Tungsten carbide 12 cobalt	WC-12Co			◎				◎			Molten Zn - resistant	Hv1000~1300	200 or more	1 or less	13.8	7.6	0.022	
		Tungsten carbide 17 cobalt	WC-17Co			◎				◎			Molten Zn - resistant	Hv1000~1200	250 or more	1 or less	11.3	8.5		
		Tungsten carbide nickel chrome	WC-27NiCr			◎				◎		○	Highly water resistant	Hv1000~1200	200 or more	1 or less	10.7	7.5		
		Chromium carbide nickel chrome	Cr_3C_2-25NiCr			◎		◎		○	○		High-temperature abrasion resistant	Hv800~1000		1 or less	6.2			
Ceramics	Alumina family	White alumina WA	99.9$Ai_2$0$_3$					◎	◎	○	○		Electrically insulated	Hv900~1000	20~40	7 or less	3.33	7.2	0.0065	
		Gray alumina A	Al_2O_3-3TiO_2					◎	◎	○				Hv900~1000	20~40	7 or less	3.33	7.4		
		Alumina 13 titania AT13T	Al_2O_3-13TiO_2					◎	◎	◎				Hv900~1000		7 or less				
		Alumina 40 titania AT40T	Al_2O_3-40TiO_2					◎	◎	◎				Hv900~1000		7 or less				
		Alumina zirconia AZ	Al_2O_3-25ZrO_2-TiO_2					◎	◎	◎				Hv900~1000		4 or less	3.67	7.3		
		Mullite WM	Al_2O_3-22SiO_2					◎	◎		○		Low thermal expansion coefficient			4 or less				
	Zirconia family	Calcia zirconia Z	ZrO_2-5.4CaO					◎	◎		◎		Thermal barrier coating	Hv700~800	15~25	12 or less	5.03	9.5	0.0028	
		Yttria zirconia YZ8	ZrO_2-8Y_2O_3					◎	◎		◎		Thermal barrier coating	Hv700~900	15~25	11 or less		10.6		
		Magnesia zirconia MZ	ZrO_2-25MgO					◎	◎		○		Thermal barrier coating		15~25					
		Zircon ZR	ZrO_2-33SiO_2					◎	◎		◎		Molten metal-resistant	Hv600~700	15~25	10 or less	3.66	4.5	0.0052	
	Others	Titania (oxidized titanium) T	99.2TiO_2		○			◎	◎	○			High-density-structured coating	Hv700~800	25~35	4 or less	4.0	7.6	0.0155	
		Chromia (oxidized chrome) CR	99.6Cr_2O_3					◎		◎		○	Solid lubricating	Hv1000~1300	20~40	5 or less	4.8	9.0	0.0069	
		Yttria (oxidized yttrium) Y	99.9Y_2O_3					◎		◎		○	Prevents high-temperature reactions							

Main thermal spraying materials and coating properties - 2

Classifications of thermal spraying methods

[ ] indicates the form of the materials
* indicates the manufacturer's product name



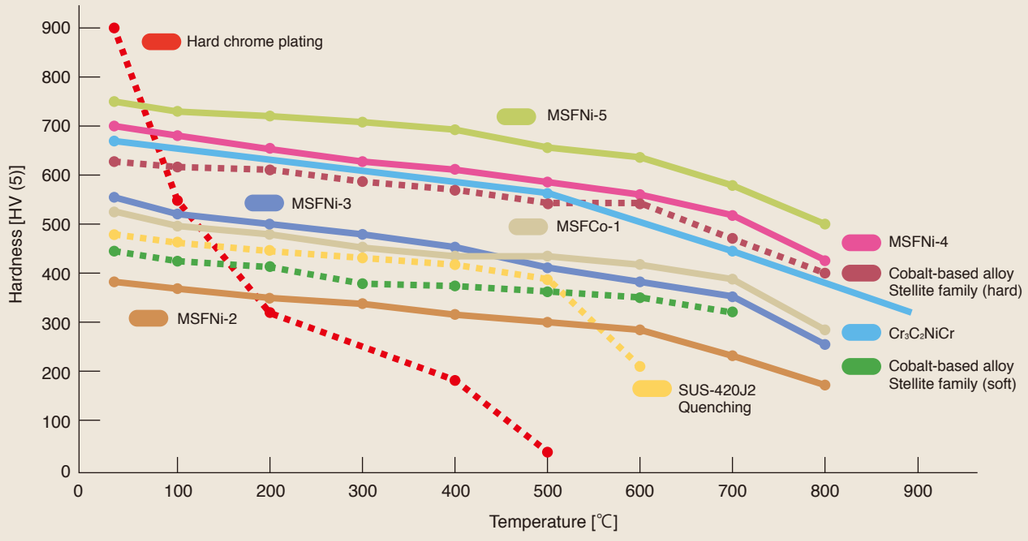
Thermal spraying rustproofing effects due to salt water spray testing

☆: No red rust ★: Red rust present

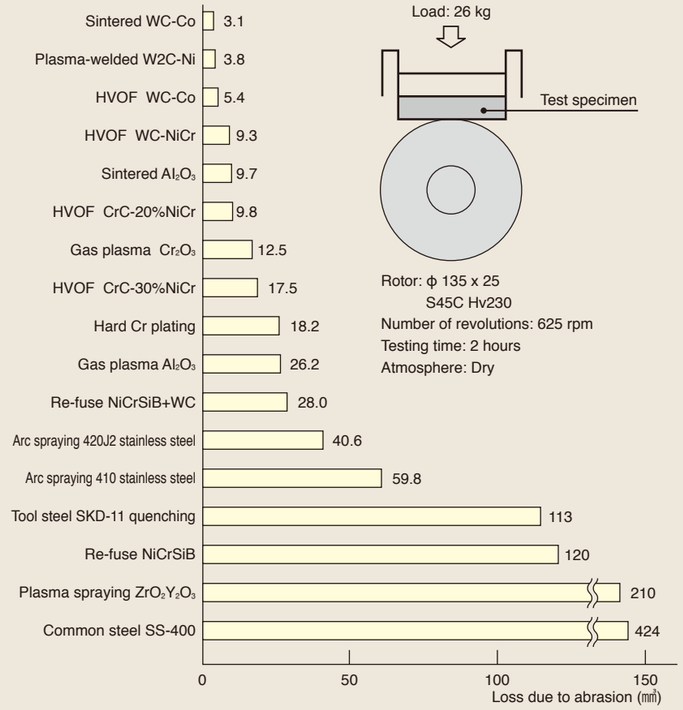
Test specimen	1,000 hours	2,000 hours	3,000 hours	6,000 hours	Comments
Al thermal spraying (80,160,200 μm)	☆	☆	☆	☆	○
Same as above, silicon or epoxy resin-sealing treatment	☆	☆	☆	☆	◎
Zn thermal spraying (80,160,200 μm)	☆	☆	☆	☆	△
Same as above, silicon or epoxy resin-sealing treatment	☆	☆	☆	☆	●～△
Zn/Al alloy thermal spraying (50,80,120 μm)	☆	☆	☆	☆	●
Same as above, silicon or epoxy resin-sealing treatment	☆	☆	☆	☆	○～●
Inorganic zinc-rich paint (40,75 μm)	☆	★	★	★	○
Thermal spray zinc plating (500 g/㎡)	☆	★	★	★	▲

* Explanation of icons in the comment section (weight change due to salt water spray testing)
◎: Least weight change △: Significant weight change
○: Minimal weight change ▲: Most weight change
●: Moderate weight change

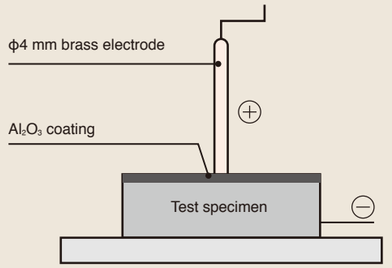
Thermal spray covering high-temperature hardness



Comparison of thermal spray coating abrasion-resistant properties

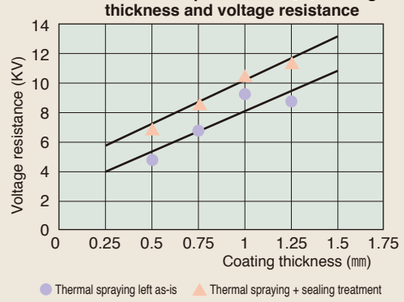


The relationship between Al_2O_3 coating thickness and voltage resistance



Measuring method for voltage resistance
As shown in the figure above, the voltage was gradually increased, and the voltage was read when sparking occurred.

Table: Relationship between Al_2O_3 coating thickness and voltage resistance



WAPLOC DATA

*: Heat treatment temperature is 1250°C

		Alumina		Mullite		Spinel		Alumina-40% titania		Zirconia-8% yttria		Zirconia-22% magnesia	
		Thermal spraying left as-is	Heat treatment	Thermal spraying left as-is	Heat treatment	Thermal spraying left as-is	Heat treatment	Thermal spraying left as-is	Heat treatment	Thermal spraying left as-is	Heat treatment	Thermal spraying left as-is	Heat treatment
Crystalline structure		γ-Al_2O_3 α-Al_2O_3	α-Al_2O_3	Mullite γ-Al_2O_3	Mullite α-Al_2O_3	Spinel	Spinel	Rutile γ-Al_2O_3	Rutile α-Al_2O_3	Cubic Tetra	Cubic Tetra	Tetra Monoclinic	Tetra Monoclinic
Density (g/cm3)		3.28	3.38	2.65	2.65	3.13	3.08	3.80	3.60	5.26	5.29	4.97	4.91
Porosity (%)		11.2	10.6	9.1	12.8	12.1	13.5	4.4	5.3	12.7	11.9	13.2	11.5
Center pore diameter (nm)		316	372	385	1577	394	392	197	158	630	610	200	630
4-point bend strength (MPa)	Room temperature	29.3	43.8	20.2	16.5	29.6	31.9	41.8	127.8	21.5	41.8	16.0	31.0
	1000℃	—	39.7	—	16.1	—	35.5	—	123.6	—	29.1	—	—
Young's modulus (GPa)	Room temperature	12.8	42.6	10.6	13.7	18.4	48.6	19.8	171.8	5.4	30.8	5.3	13.0
	1000℃	—	36.4	—	14.8	—	31.0	—	93.3	—	45.7	—	—
Thermal expansion coefficient (X10-⁶)	-600℃	8.3		5.0		8.6		1.7		8.1		—	
	-1000℃	8.9		5.6		9.1		4.9		9.0		—	
	-1400℃	9.3		6.1		9.5		6.9		9.9		—	
Shrinkage ratio (%)		—	0.7	—	0.5	—	0.0	—	0.6	—	0.2	—	0.4

This production base for thermal spraying leads our generation in new technical development

Senboku Factory

Thermal spraying is a surface covering and treatment technique that deposits a film of melted materials such as ceramics, cermets, metals or resins onto a surface material to make it more wear- heat- or corrosion-resistant, or improve properties such as electrical insulation. Widely used in industrial fields requiring advanced functions, thermal spraying is used to make products such as communication satellites, high-rise steel structures, industrial machinery parts, electronic devices and consumer appliances. Senboku Factory specializes in advanced thermal spraying technologies, and assists Amagasaki Factory as a major production base for large products manufactured with thermal spraying.

Amagasaki Factory

OFIC has accumulated a wide range of technical expertise over many years of manufacturing, machining and repairing steelmaking equipment. The essence of this expertise is brought together at Amagasaki Factory. Starting with materials procurement, Amagasaki Factory uses technology such as machining with large machine tools, finishing with precision machinery, special welding : automatic hardfacing powder plasma welding, general welding. Its integrated work system spans all processes from inspection through assembly and adjustment. Working closely with OFIC's engineering departments, the factory draws on its comprehensive lineup of technical expertise to precisely meet various needs ranging from equipment design to manufacture and installation.

Omigawa Factory

In 1969, Omigawa Factory moved to a massive site of around 22,000 square meters that OFIC had acquired in Chiba's Omigawa Industrial Park which located in Chiba Prefecture . After initially working on pressure vessel fabrication and overlaying, the site steadily expanded its activities by constructing a specialized machining plant, a plant for large roll overlaying and large pressure vessel fabrication, and a thermal spraying plant. In 2004, Omigawa Factory installed technology for manufacturing small forged hardened steel rolls.

Technological Development

Through overlay welding and thermal spraying technologies, technological development for functional deposit forming with various qualities such as corrosion resistance, wear resistance, scoring resistance and impact resistance are promoted. Using the technologies that we have developed, we greatly contribute to advanced product development in various fields.

Company Profile

Name	OSAKA FUJI Corporation
Head Office	1-9-1 Jokoji, Amagasaki-shi, Hyogo 660-0811 Japan Phone:+81-6-6487-1865 / Fax:+81-6-6488-1623
Representative	Mitoji Oshima, President and CEO
Established	March 19, 1955
Capital	$1,180,875 (¥94.47 million)
Businesses	Steel manufacturing process work, machining, welding and thermal spraying, engineering,design and manufacture of industrial machinery, and slicing process
Major customers	Nippon Steel & Sumitomo Metal Corporation / JFE Steel Corporation / Kobe Steel, Ltd.