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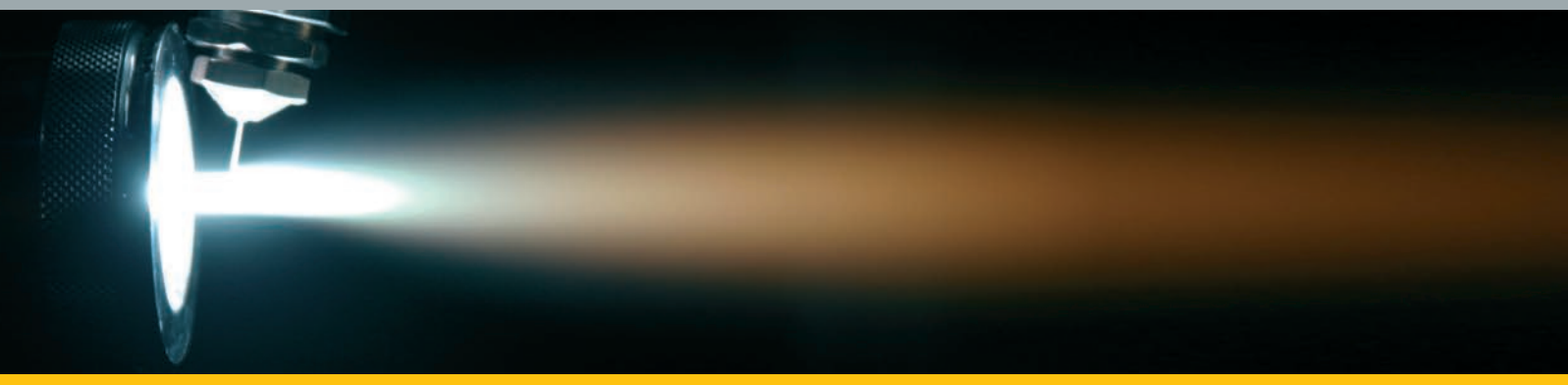
FRAUNHOFER-INSTITUT FÜR WERKSTOFF- UND STRAHLTECHNIK IWS



STATE-OF-THE-ART THERMAL SPRAY COATING SOLUTIONS

Functionalization of metal, glass, and plastic surfaces; Multifunctional coating systems; wear and corrosion protection

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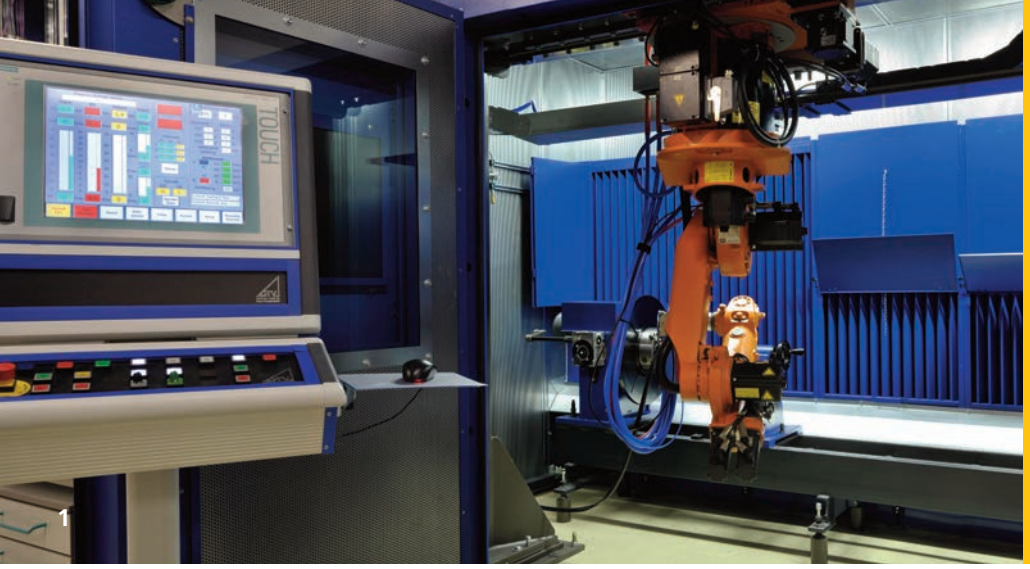
Technology

Thermal spraying is an established surface technology used in a wide variety of industrial applications. The materials predominantly used for thermal spray coating solutions include ceramic materials as well as metals and hard-metals. Coating thickness is typically between 100 and 500 µm, with thicknesses outside this range being possible for spe- cific applications. State-of-the-art thermal spray coatings are characterized by high densities and adhesive strengths.

System equipment in a symbiotic relationship with extensive know-how in the field of materials engineering and development forms a core competency in the field of thermal spraying at Fraunhofer IWS.

Available Equipment

- two spray booths for separation of materials (metals and ceramics) – robot-assisted process
- coating of three-dimensional part surfaces
- maximum size for rotationally symmetric parts: l = 2500 mm, d = 600 mm
- high velocity oxy-fuel spraying (HVOF, using gas and paraffin as fuel, oxygen as oxidant)
- high velocity air-fuel spraying (HVAF, using gas as fuel, compressed air as oxidant)
- delta plasma (APS system with high powder throughput and high economic efficiency)
- atmospheric plasma spraying (APS)
- suspension spraying (HVOF and APS)



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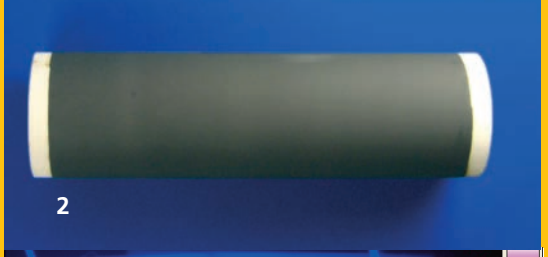

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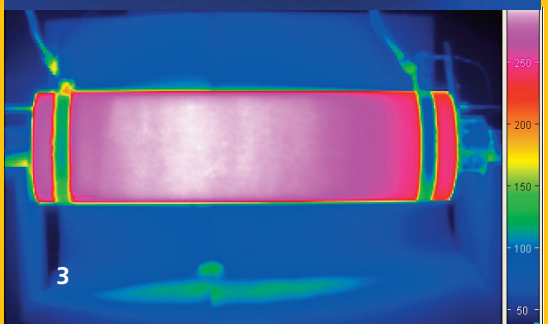

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Hardmetal Coatings

Up to now hardmetal coatings prepared by high velocity oxy-fuel (HVOF) spraying have been mainly used for improving resistance to abrasion, erosion, and dry sliding wear. Use of state-of-the-art spray technologies in combination with advanced coating materials enables coated parts to be used in high rolling contact load conditions such as are found in high-performance gears.

At Fraunhofer IWS, focus is on development, manufacture, and microstructural characterization of thermally sprayed coatings. Hardmetal coatings based on TiC are developed to supplement the conventional WC-Co- and Cr_3C_2-NiCr-based solutions. Advantages are yielded from the high wear resistance, good dry sliding wear properties, and low density (weight reduction).

Suspension spraying

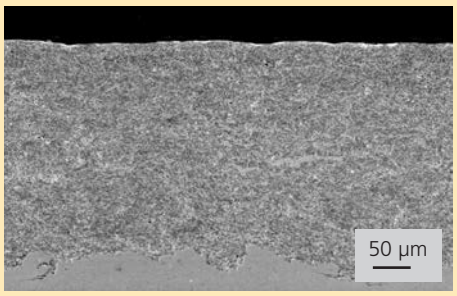
Suspension spraying is a new thermal spray process technology in which suspensions are used instead of coating powders, predominantly in conjunction with APS and HVOF processes. Apart from development of suitable suspensions, adaptation of the equipment used for feeding as well as for injection into the plasma or flame is necessary. Advantages of and potential applications for suspension-sprayed coatings are manifold, one of the main positive aspects being the possibility to obtain coatings with thicknesses of a few µm and high adhesive strengths. Coating thicknesses of 10 – 50 µm close the technological gap between traditional spray coatings and other surface technologies in terms of achievable coating thicknesses. Modified phase compositions in well-known materials such as alumina and titania can lead to new coating properties (e.g., photocatalytic activity).

Multifunctional ceramic coating systems

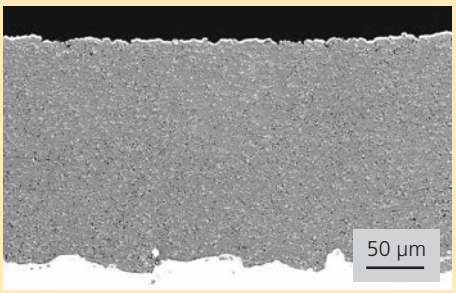
Ceramic materials, especially alumina, titania, chromia, and zirconia, are used extensively as low-cost coating solutions. They offer a wide variety of properties, allowing for the preparation of wear- or corrosion-resistant as well as electrically conductive or insulating coatings.

Multilayer coatings enable various functionalities to be combined and novel performance characteristics to be developed. Multilayer ceramic heating elements (Figures 2 and 3) that can be sprayed onto parts with various geometries and thermoelectric generators are examples of the wide variety of possible new applications.

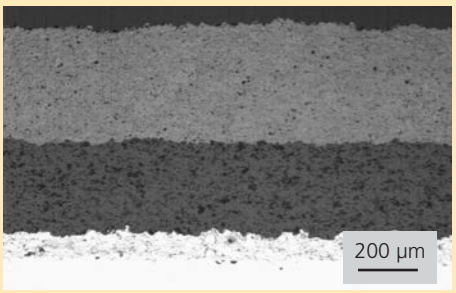
1 Equipment available at IWS for APS, HVOF, and suspension spraying
2 Multilayer ceramic heating element on a roller
3 Thermographic image of a roller in operation



HVOF-sprayed (Ti,Mo)(C,N)-Ni hardmetal coating



Suspension-sprayed alumina coating



Multilayer coating system on a steel substrate: NiCr and Al2O3 (APS), titania (APS) (bottom to top)