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Dresden

FRAUNHOFER-INSTITUT FÜR WERKSTOFF- UND STRAHLTECHNIK IWS



## SUSPENSION THERMAL SPRAYING

An industrial breakthrough for thermal spraying

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### Task

Thermal Spraying is an established surface technology, with high flexibility in terms of processes and possible coating materials. Atmospheric Plasma Spraying (APS) and High Velocity Oxy-Fuel Spraying (HVOF) are among the most applied spraying techniques to produce coatings with typical thicknesses in the range 100 – 500  $\mu\text{m}$ .

The substitution of the conventional spray powders by suspensions offers new possibilities, such as the direct use of finely dispersed powders and the production of nanostructured coatings.

### Advantages

The advantages of spraying with suspensions include:

- different and improved coating properties (e.g. different phase compositions) when compared to conventional coatings,
- thicknesses in the range 10 to 50  $\mu\text{m}$  are possible – potential to fill the technological gap between thermal spraying and thin film techniques,
- use of powder with sizes from nanometers up to 10  $\mu\text{m}$ ,
- lower surface roughness,
- less anisotropic coating,
- thickness and hardness values can be achieved in the similar range as conventional coatings.



## Equipment

In order to be able to spray suspensions, specific hardware components are needed: suspension feeder and suspension injector. Thus, the technology can be easily integrated into the existing spray equipment. At the Fraunhofer IWS, the suspension spraying was successfully adapted to an APS F6 Gun and to a HVOF TopGun (Fig. 1).

With the used suspension feeder, constant flow rates can be maintained and a high process stability assured. Moreover, the wear of the components is low. With a feeding rate from 5 up to 100 ml min<sup>-1</sup>, deposition efficiencies between 50 and 70 % are obtained. Depending on the system, the suspension can be both axially (internal), as well as radially (external) injected into the flame or plasma. An atomizer or a mechanical injector can be used.

## Suspensions

Suspensions, with solid contents ranging from 5 to 50 wt. %, are prepared by dispersion of fine powders in solvents. In the feedstocks, used up to now, ceramic materials predominate. Distilled or deionized water, alcohols, or water-alcohol mixtures are usually used as solvent.

The key characteristics of the suspension are the solids content, the grain size distribution of the dispersed powder, and the viscosity. Homogeneity and long-term stability are decisive for the quality of the resultant coatings. They are crucial for the production and optimization of suspensions. Moreover, in the development of suspensions, safety, environmental, and health aspects, as well as possible corrosive effects on the system equipment, must be considered.

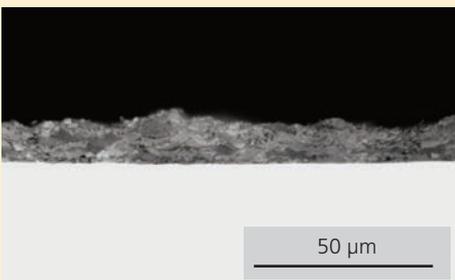
## Offer

Fraunhofer IWS offers a comprehensive range of services for the thermal spraying with suspensions. These include:

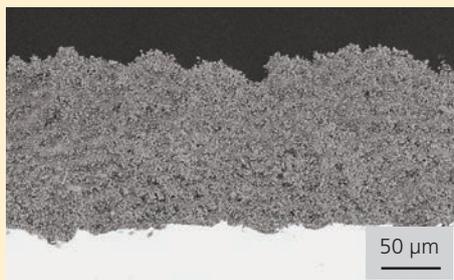
- development (in cooperation with Fraunhofer IKTS) and testing of suspensions,
- development and non-destructive characterization of tailored coatings solutions (Young's modulus, density, adhesion problems, cracks),
- tailored coating components,
- technology transfer.

1 Suspension spraying system at Fraunhofer IWS

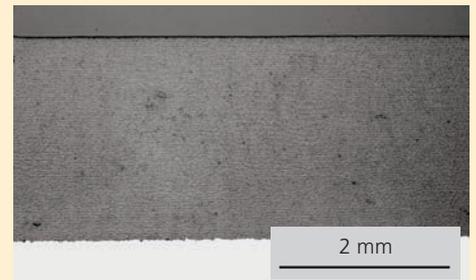
### Examples of coatings deposited by spraying with suspensions



15 µm TiO<sub>2</sub> coating on a smooth stainless steel substrate



160 µm porous Al<sub>2</sub>O<sub>3</sub> coating on a steel substrate



2,7 mm Al<sub>2</sub>O<sub>3</sub> coating on a steel substrate