Coating Materials (selection)

- Y₂O₃ stabilized ZrO₂ thermal barrier coating
- Segmentation cracks in a thermal barrier coating
- Columar structured Y₂O₃ stabilized ZrO₂ thermal barrier coating
- Boron carbide for first wall in a fusion reactor

- alloys
  - e.g. MCrAlY, NiCr, stainless and ferritic steels
- metals
  - e.g. tungsten, copper, titanium
- oxide ceramics
  - e.g. ZrO₂, Al₂O₃, TiO₂, spinels, pyrochlores (e.g. La₂Zr₂O₇), perovskites, aluminates
- others
  - e.g. B,C, WC/Co

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Thermal Spraying
Mai 2012
Thermal spraying - comprising plasma spraying (PS) and high velocity oxy-fuel spraying (HVOF) - are highly economical processes for the deposition of metallic or ceramic coatings.

The process of plasma spraying is based on melting and accelerating powders in a plasma jet, which is generated by ionization of a gas mixture flow. The variety of parameters e.g. gas composition, gas flow, current, spraying distance, powder size distribution, carrier gas flow, ambient pressure and others determine the melting performance and velocities of the particles and thus have a significant influence on the resulting microstructure.

Plasma and particle in-flight characteristics are analysed to gain an understanding of the process and to manage quality.

### Suspension Plasma Spraying (SPS)
Suspension Plasma Spraying (SPS) is an APS process using a liquid suspension as carrier for the powder feedstock. Thus, it is possible to process particles within the sub-micrometer range allowing for new microstructured coatings.

### Vacuum Plasma Spraying (VPS)
By means of vacuum plasma spraying (VPS), ceramic and especially metallic coatings are deposited with negligible oxygen take-up.

- Vacuum/ inert-gas/ reactive PS
- Torches: F4 (55 kW), TriplexPro-210 (65 kW)

### Low Pressure Plasma Spraying (PS-PVD)
Low Pressure Plasma Spraying is an enhanced VPS process operating at very low pressure with high plasma power. Thus, the deposition of thin and dense coatings is possible, even the deposition from the evaporated state of the feedstock materials allowing for advanced microstructures.

- Torch: O3CP (160 kW)

### High Velocity Oxy-Fuel Spraying (HVOF)
In contrast to plasma spraying, the HVOF process implies particle velocities being much higher at relatively moderate flame temperatures which signifies the suitability of the process especially to deposit metallic alloys like cemented carbides and MCrAlY bond-coats.

- Torches: DJ2600, DJ2700, Hybrid-Aircap
- Hydrogen/Methane-Oxygen process with Air/N2-shroud gas

### Plasma Diagnostics
- Enthalpy-probe TEKNA ENP-04-CS calorimetric/mass-spectroscopic determination of plasma enthalpy, temperature and composition, as well as plasma velocity
- Optical emission spectroscopy plasma gas composition, temperature and electron density

### Particle Diagnostics
- Tecnar DPV-2000 Two-color pyrometric measurement of particle temperature, time-of-flight determination of particle velocity, estimation of particle diameter, flux measurement
- Tecnar Accuraspray-g3 Two-color pyrometric measurement of particle temperature, cross-correlation based determination of particle velocity, plume intensity profiles by digital video image processing

### ICP - Sensor
- In-situ measurement of deposition and thermal mismatch stresses in coatings