Fraunhofer
ICT

FRAUNHOFER INSTITUTE FOR CHEMICAL TECHNOLOGY ICT

1

1 *High-temperature chamber for X-ray diffractometry.*

THERMAL INSULATION AND OXIDATION PROTECTION

THERMAL INSULATION, OXIDATION, CORROSION AND STRUCTURE STABILITY

Multipurpose high-temperature coating based on particles

Thermal barrier coatings play an essential role in protecting metallic materials against high temperatures. Fraunhofer ICT has developed a multifunctional coating system based on slurry for high temperatures, consisting of a topcoat made from sintered hollow alumina spheres and a metallic diffusion layer below. The topcoat acts as a thermal barrier and the diffusion layer offers protection against oxidation and corrosion.

Applications

- Gas and steam turbines: Oxidation protection and thermal barrier coatings.
- Combustors, steam boilers, etc.
- Fire protection for steels in the construction sector.
- Coatings for high-temperature electrolysis and fuel cells.

Services

- Development of multipurpose coatings with thermal barrier and corrosion protection, exploiting the specific properties of metallic micro- and nanoparticles.
- Testing of thermal barrier coatings by applying temperature gradients through heating one side only.
- Testing of materials and components for gas and steam turbines as well as steam electrolysis under pressure and controlled atmosphere (e. g. steam and pure oxygen).

Fraunhofer Institute for Chemical Technology ICT

Joseph-von-Fraunhofer-Strasse 7
76327 Pfinztal (Berghausen)
Germany

Contact

Dr. Vladislav Kolarik
Phone +49 721 4640-147
vladislav.kolarik@ict.fraunhofer.de

www.ict.fraunhofer.de

Facilities:

High-temperature ovens

- Pressurized furnace for material tests at temperatures up to 1000 °C and pressures up to 50 bar in oxygen, hydrogen and steam-hydrogen.
- Autoclaves for application-oriented pressure tests, e.g. 850 °C and 30 bar in steam or oxygen, 650 °C at 300 bar in steam.
- Horizontal tubular furnace for temperatures up to 1700 °C.
- Vertical furnace for cyclic oxidation tests up to 1200 °C for samples of max. 12 cm diameter.
- Horizontal tubular furnace for experiments under hydrogen or corrosive atmosphere; temperatures up to 800 °C.
- Muffle furnace for temperatures up to 1100 °C.

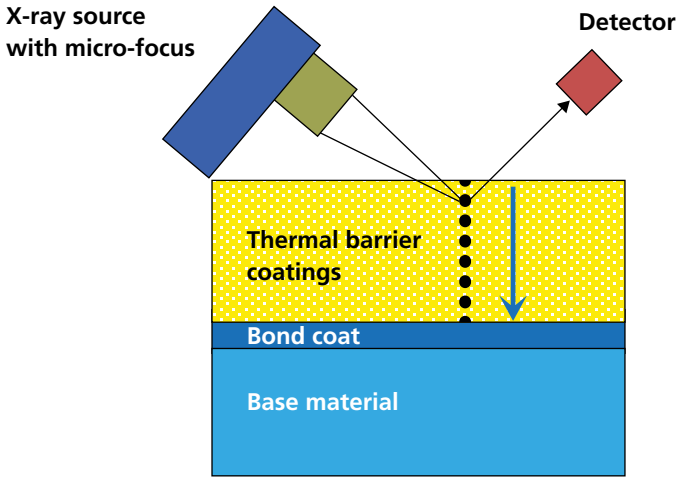
Field emission scanning electron microscopy

- Field emission scanning electron microscope Supra 55 VP from Zeiss with variable pressure, equipped with energy dispersive X-ray spectroscopy (EDX) and STEM.
- Field emission scanning electron microscope EVO 60 from Zeiss with variable pressure and EDX.
- Ultramicrotome EM UC6 Leica for sample preparation for STEM.

High-temperature X-ray diffractometry as in-situ analysis method

The measuring system consists of an X-ray diffractometer with a high-temperature chamber for isothermal measurements and freely-selectable temperature programs up to 1400 °C.

- In-situ identification of corrosion products as a function of temperature and time
- Simultaneous detection of the thermal expansion coefficients of all phases in the oxide layer and the substrate.
- In situ detection of mechanical stresses in the materials.
- In situ detection of recrystallization effects at high temperatures.
- Spatially-resolved mapping analysis using focusing X-ray optics.



Set-up for spatially-resolved mapping analysis by X-ray diffraction with micro-focus.

2 *SEM image of microscale aluminum particles after oxidation.*