

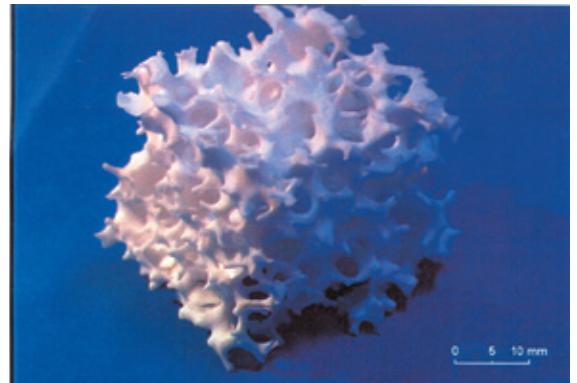
Ceramic Materials

Synthesis, properties and applications

In the laboratory of ceramic materials, the complete process chain of synthesis and production of advanced ceramic materials for industrial applications can be reproduced on a prototype scale. A broad range of relevant ceramic materials is subject of investigations.



Ceramic parts for technical applications



Ceramic foam material

Synthesis of powders and ceramics

Powder preparation

Precipitation
Colloidal processing, Sol-Gel
Powder surface modification
Selection and design of process additives

Shaping

Casting, pressing, extrusion, new shaping techniques

Sintering

Thermal treatment at temperatures up to 1800 °C under vacuum, reactive or protective gases

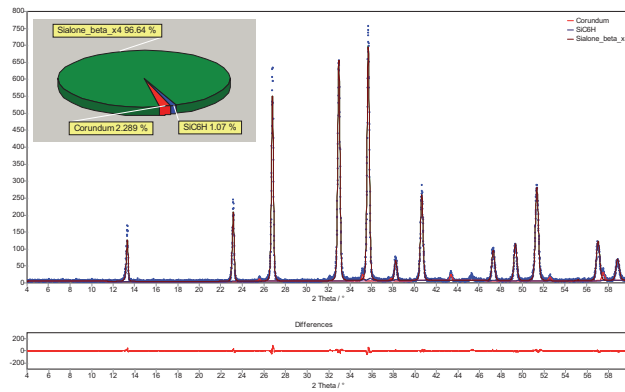
Characterisation

Powder characterisation

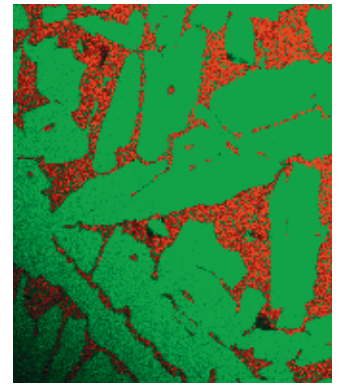
Crystal structure and phase composition of powders and ceramics by XRD
Investigation of mechanical properties of ceramics (hardness, strength, tribological properties)
Microstructure and defects by SEM, EDX
Surface properties by XPS



XRD xray diffraction goniometer



XRD powder pattern, quantitative rietveld analysis



Microstructure of composite material by SEM/EDX – element mapping

Applications

Advanced ceramic materials are used in a wide range of industrial applications as functional materials for e.g.

- separation (membranes, filter)
- electronic devices (active and passive elements)
- biomaterials

- thermal management (insulation, thermal barrier, refractory materials)
- materials for extraordinary mechanical and chemical property requirements

Selections of materials and process routes have to be adapted to individual product and process requirements

Infrastructure

Structural characterisation

X-ray diffraction system (XRD) with temperature chamber up to 1600 °C, crystallographic phase identification and quantification by Rietveld analysis
FTIR

Thermal analysis

Dilatometer – Thermal expansion coefficient
Differential scanning calorimetry (DSC)
Thermogravimetry (TGA)
Thermomechanical analysis (TMA)

Particle characterization

Particle size analyzer

Colloidal properties

Rheometer (Rotation, Oscillation, Temperature chamber)
Zeta potential analyzer
Stability analyzer (analytical photo centrifuge)

Surface modification

Physical vapour deposition (PVD)
Plasma activation, spincoating
Fluidized-bed coating

Surface characterization

Contact angle and surface tension measurement
X-ray photoelectron spectroscopy (XPS)
FTIR and XRD at grazing incidence reflection

Mechanical Testing

Electromechanical test machine, equipped with extensometer and heat chamber
Hardness testing (Rockwell, Brinell, Vickers)
Micro-hardness test system
Instrumented impact fracture test system

Wear and friction testing

Pin-on-disc tribometer

Microscopy, material analysis, failure analysis

Scanning electron microscope (SEM), including energy dispersive analysis (EDX)
Light microscopes, including digital imaging software
Ceramographic preparation facilities for light microscopy and SEM

Heat treatment

Up to 1800 °C, optional vacuum or controlled gas atmosphere