

# Materials and Process Engineering

## Equipment for Testing and Analysis of Materials and Surfaces

### Surface Analysis and Characterization

- Scanning electron microscopy (VP-SEM, combined with EDXS)
- Atomic force microscopy (AFM, temperature range: RT to 100 °C)
- X-ray photoelectron spectroscopy (XPS)
- Auger spectroscopy (SAM)
- 3D microscopy (confocal and interferometric)
- IR and Raman scanning microscopy
- Correlative microscopy: light, 3D, SEM/EDS, SAM/XPS, AFM, IR, Raman
- Angle dependent UV/VIS/NIR measurements in reflection and transmission
- Diffuse absorption spectroscopy and reflection spectroscopy
- Colorimetry
- ATR infrared spectroscopy
- Contact angle determination, surface tension/-energy
- Physisorption, chemisorption (TPO, TPR, TPD)



x-ray photoelectron spectroscopy (XPS)

### Structure and Microstructure Analysis

- X-ray diffraction analysis (XRD, temperature range: RT to 1600° C)
- Metallography and ceramography

### Particle Analysis

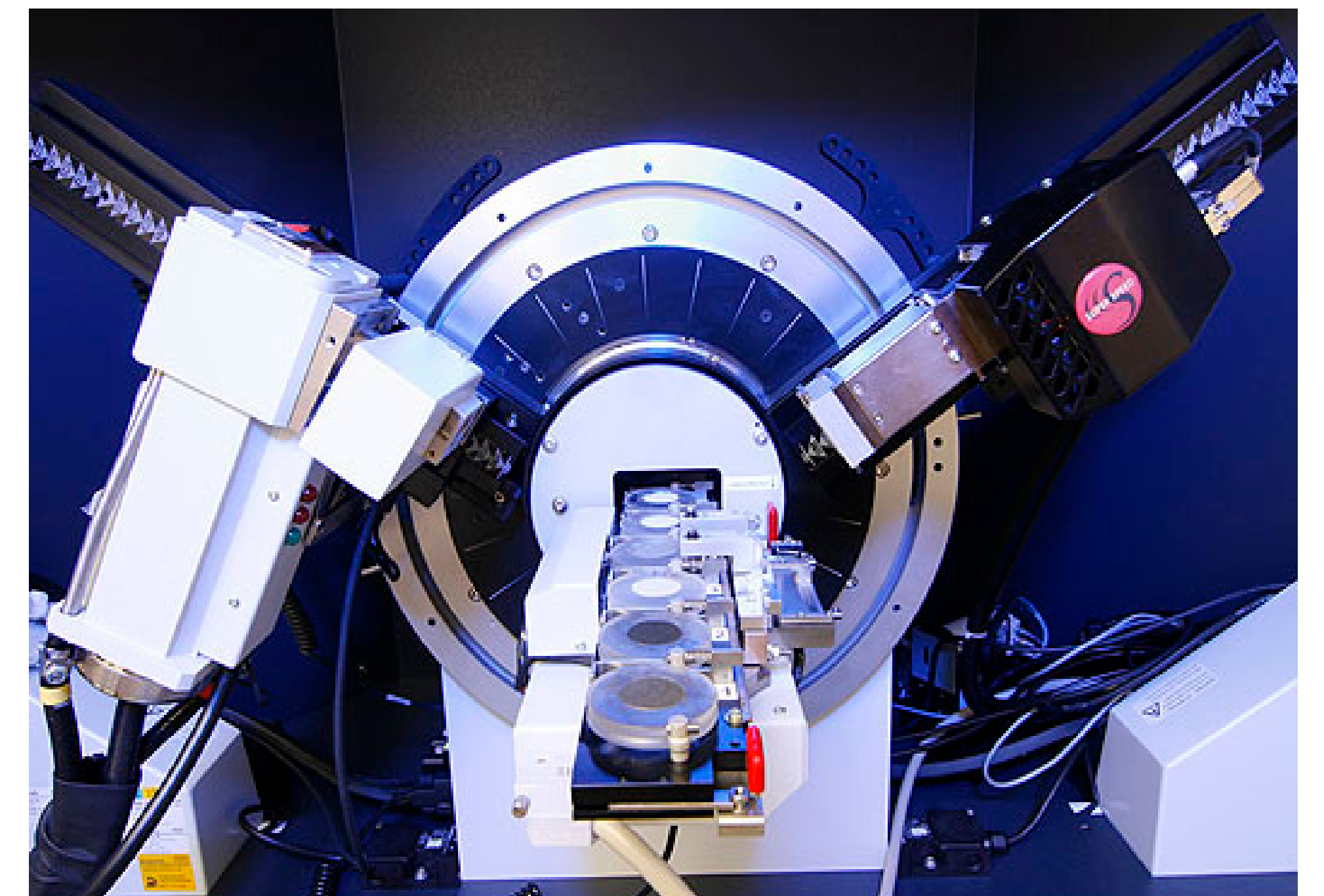
- BET (specific surface, porosity)
- Laser diffraction, coultercounter, DLS dynamic light scattering (particle size determination)
- Zetapotential (CVP colloid vibration potential)

### Tribology (friction and wear)

- High temperature tribology (oscillating, temperature range: RT to 900 °C)
- Pin-on-disk tribology

### Spectroscopy and Chemical Analysis

- Trace element analysis (ICP-OES)
- Spectroscopy (UV/VIS NRI, FTR, fluorescence)
- Process analytics in condensed (IR) and gas phase (RAMAN, MS)
- Titration methods (e.g. water content determination)
- Chromatography (GC-MS, HPLC, IC, sulfur on-line)
- Electrochemical workstation
- Electrochemical impedance spectroscopy (temperature range: 0 to 1200 °C)



x-ray diffraction analysis (XRD)

### Thermal Analysis

- Thermal expansion and phase transformations (dilatometer) (temperature range: RT to 1600°C)
- Thermal analysis (DTA/TG) combined with FTIR-spectroscopy (EGA)
- Differential scanning calorimetry (DSC) (temperature range: -160 °C to 700 °C)
- Thermic surface analysis (TPX) linked with MS (temperature range: RT to 1200 °C)

### Mechanical Testing

- Servohydraulic and electromechanical universal testing systems (temperature range: -80 °C to 1100 °C, up to 250 kN)
- Resonance testing system
- Dynamic and mechanical thermal analysis (DMTA) (temperature range: -110 °C to 450 °C)
- Rheometry (with UV, temperature range: -100 °C to 450 °C)
- Deformation analysis and stress analysis



scanning electron microscopy (SEM)

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