

Competence Centre for Materials Characterisation

Department 11, Materials Science



Extended characterisation service from one source

The Competence Centre for Materials Characterisation within the Institute of Materials Science offers companies and research centres a great variety of analytical and structure investigation services. In the frame of the Material Forschungsverbund Rhein-Main (MatFoRM) we also have a strong cooperation with other groups from different departments like the Materials Testing Laboratory Darmstadt (Staatliche Materialprüfungsanstalt, MPA) and the Fraunhofer-Institute for Durability and System Reliability (LBF).

MatFoRM-TUD is a network in materials sciences and material technologies in the Rhein-Main region. This network opens the door to university research and development activities in material science and application. MatFoRM-TUD offers interdisciplinary research within the complete spectrum: from the material to the component and to the system.



Chemical Analysis

In terms of chemical analysis we are focusing on position resolving methods, chemical bonding analysis and trace analysis. The highest position resolving method can be realised by Electron Energy Loss Spectroscopy (EELS) within a Transmission Microscope (TEM) where precipitates in the range of a few nm can be analysed. The Secondary Ion Mass Spectroscopy (SIMS) can be used to analyse samples lateral and depth resolved with very good detection limits.

Chemical bonding and surface sensitive investigations are performed by X-ray photoelectron spectrometry (XPS). Beside the position resolving methods we also offer bulk analytic methods like X-ray fluorescence spectrometry (XRS), atom absorption spectrometry (AAS) and inductively coupled plasma optical emission spectrometry (ICP).

Structure Analysis

To investigate the structure of materials various x-ray diffraction methods and electron-microscopical methods are provided. More than ten x-ray diffractometers are available to analyse the structure, texture and also strain and stress in various environmental conditions (XRD, GIXD). The density, thickness and roughness of films and film systems can be analysed by x-ray reflectometry (XRR). The conventional Transmission Electron Microscopy (TEM) can be used to analyse crystal phases and orientations by electron diffraction methods. Crystal planes can also be observed directly by high resolution TEM to analyse grain boundaries as well as defects.

Topographic Methods

Various High Resolution Scanning Electron Microscopes (HSEM) are available to analyse surfaces with a resolution in the nm range. The HSEM and SEM microscopes are also equipped with an EDX system to analyse the chemical composition at a local spot or to record a two dimensional element map. To analyse materials at various pressures an Environmental Scanning Electron Microscope (ESEM) is also provided.

Thermal Analytics

To study the material properties at different temperatures a wide range of thermal analytics is available. The change in volume or length can be analysed by Dilatometry (DIL) or Thermo Mechanical Analysis (TMA), the heat difference by Differential Scanning Calorimetry (DSC), the change of mass by Thermo Gravimetric Analysis (TGA) and the thermal diffusivity and thermal conductivity by Laser Flash Analysis (LFA).



Secondary Ion Mass Spectroscopy (SIMS)

Mechanical and Electrical analysis

The mechanical properties of metals and ceramics can be tested under various conditions. Beside tension and pressure it is also possible to analyse the flexibility and the fracture toughness. To study the electrical properties it is possible to record the characteristic line of the current vs. voltage or the luminescence of materials like OLEDs.

Combination of Methods

In many cases it is not sufficient to use just one single method. The main advantage is that all above mentioned characterisation methods are available in one department and can be combined individually. Especially the position resolving methods to characterise the structure and the chemical composition should be combined with the measurements of the various properties of the material.



Element map for iron on an indexable insert of cubic boron nitride

Competence Centre of Materials Characterisation

Services

The Competence Centre of Materials Characterisation within the Institute of Materials Science offers companies and research centres a great variety of analytical and structure investigation services.

Chemical analysis

- Bulk or average analysis
- Precision analysis
- Ultratrace analysis
- Elementdistribution analysis

Structural analysis

- Structure determination
- Phase analysis
- Real structure analysis
- Texture analysis
- Thin film analysis
- Particle characterisation
- Magnetic structure

Mechanical testing

- Tension test
- Heat tension test
- Pressure test
- Flexibility test
- Fracture toughness test
- Elasticity coefficient
- Time to rupture curve test
- Relaxation test
- Strain variation test

Corrosion testing

- Electromechanical corrosion
- Wear test
- Stress corrosion cracking

Thermal analysis

- Differential thermal analysis
- Differential scanning calorimetry
- Dilatometry
- Dynamic mechanical analysis
- Laser flash analysis
- Thermogravimetric analysis

Fundamental Research

- Short and longterm research services
- Extensive research
- Basic material development

Modelling and Simulation

Synthesis

- Synthesis of pure substances
- Thin film growth
- Preparation of nano particles and fibers

Electrical analysis

- Current voltage characteristic line
- Luminescence characteristic line
- Impedance spectroscopy
- Coulometry

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