# ANALYTICAL METHODS

## CHROMATOGRAPHIC METHODS
- Gas chromatography/mass spectrometry
  - GC/MS with head space
  - GC/MS with thermodesorption
  - GC/MS with pyrolysis
- HPLC with UV-/DAD-/RI-detection as well as fluorescence and conductivity detector
- GPC with RI/UV detection as well as light scattering and viscosity detector
- Ion chromatography

## SPECTROSCOPIC METHODS
- FT-IR spectroscopy with ATR and various cuvettes
- UV/VIS/NIR spectroscopy with Ulbricht sphere
- Raman spectroscopy combined with AFM
- Atomic absorption spectrometer (AAS) with flame, graphite tube for solids and solutions
- X-ray fluorescence analysis (XRF)
- MALDI-TOF-MS
- Optical emission spectroscopy

## THERMAL PROCESSES
- DSC (differential scanning calorimetry) ranging from -100 °C to 600 °C (up to 1 500 °C with heat-flux DSC)
- DMA (dynamic mechanical analysis) ranging from -170 °C to 1 000 °C
- TG-DTA/DSC (thermogravimetry with differential thermal analysis) from RT up to 1 500 °C
- Dilatometry/thermomechanical analysis (TMA) from -170 °C (TMA) up to 1600 °C (dilatometer)
- Thermal conductivity from 0.01 up to 400 W/(m*K) in the range between -40 and 180 °C

## MICROSCOPY TECHNIQUES
- Field emission scanning electron microscopy (FEM) with energy-dispersive electron beam microanalysis (ESMA)
- Atomic force microscopy (AFM) with ULTRA objective
- Stereo incident light microscopy (H/D/DIC)
- Inverse incident light microscopy (H/D/DIC)
- 3D microscopy
- Interference microscopy
- Microscope image analysis
- FT-IR microscopy
- Laser scanning microscopy

## SURFACE ANALYSIS
- X-ray photoelectron spectroscopy (XPS)
- Contact angle measurements (dynamic and static contact angle, tensiometer)
- Tactile and optical profilometry
- Zeta potential measuring instrument
- Pyrolysis GCMS with special sampling

## OPTICAL METHODS
- 2D scattered light measurement
- Micro and macro twist measurement
- Brewster angle measurement
- Speckle interferometry measurement
- Spectral ellipsometry

## MAGNETIC METHODS
- Hysteresis loop measurement open circle up to 6.5T ( -40 to 180 °C)
- Permeability measurement (100 kHz to 125 MHz)
- Stray field measurements (0.1 mT to 1 T)
- Magnetic moment / determination of the magnetization angle
- Faraday rotation measurements
- Magnetic field scanning
- Dipole/multipole magnetization processing

## ELECTROCHEMICAL METHODS
- Corrosion tests (potentiodynamic measurements, electrochemical impedance spectroscopy, galvanodynamic measurements)
- Voltammetry/cyclic voltammetry
- Corrosion current measurement

## MATERIAL TESTING
- Rheology
- Hardness test acc. to Vickers, Brinell and Buchholz
- Determination of the hardness acc. to Shore A/D
- Scratch hardness test acc. to Sikkens & Clement
- Tensile, compression, shear, peel and bend test pursuant to DIN
- Erichsen cupping test
- Mandrel bend, ball impact and ultra-sound test
- Permeation measurements gas/water vapor/ volatile organic compounds (VOC)
- Texture analysis
- Electrical conductivity measurement
- Particle size distribution analysis
- Layer thickness measurements (ellipsometer, profilometer, scattered light measurement, prism coupler)
- Karl Fischer titration for determining the water content
- Determination of the refractive index and the absorption coefficient with an ellipsometer
- Absorption measurement in the high-frequency field
- Pyknometer (density, porosity)
- Digital holography
- Shrink measurement for adhesive curing

## CLIMATE AND CORROSION TESTS
- Corrosion test chamber for salt spray test
- Xenon arc and UV fluorescence test
- Climate, condensation water and alternating load tests, weathering tests (outdoor weathering)
- Temperature shock chamber

## BIOLOGICAL TESTING METHODS
- Vitality test (live/dead-Assay)
- Colorimetric and fluorimetric determinations
- Enzyme activity measurements
- Microbiological test methods
- Enzyme-linked immunosorbent assay (ELISA) tests
- Immunohistochemistry
- Protein analytics (SDS-PAGE, Westernblot)
- DNA/RNA analytics(PCR, RT-PCR, nucleic acid electrophoresis

# FACTS

INNOVENT is a non-profit industry-oriented research institution

- Founded 1994 in Jena
- Since 2001 at the industrial park Jena-Göschwitz in our own institute building with 1,500 m² laboratory area
- 2003 Expansion of the usable space by 800 m² with the technical center
- 2019 Expansion of the technical center by 2,150 m² at another location in the industrial park Jena-Nord
- Over 130 R&D employees (chemists, physicists, biologists, engineers, etc.)
- Processing of publicly funded individual and joint projects (national and international) and direct industrial projects
- Supervision of qualification work (BA, MA, diploma, doctorate) and internships as well as teaching assignments at various universities
- Spin-off of various companies in the fields of surface technology, plant engineering and magnetic systems
- Organization of the ThGOT Theme Days on Interfacial Engineering and Surface Technology (www.thgot.de), initiation of the ak-adp User Forum Atmospheric Pressure Plasma (www.ak-adp.de), foundation of the Forum INN-O-KULTUR (www.innokultur.de)
- Founding member of the German Industrial Research Association Konrad Zuse (Zuse-Gemeinschaft)

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## TECHNOLOGY DEVELOPMENT JENA

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## SURFACE TECHNOLOGY

### FUNCTIONAL SURFACES
- Development of adhesion-promoting, easy clean, photocatalytic, (transparent) conductive, optical, switchable layers and antimicrobial or bactericidal surfaces

### THIN-FILM TECHNOLOGY
**Atmospheric pressure processes**
- Reactive surface activation and coating by flame pyrolysis or normal pressure plasmas
- Functional composite coatings with normal pressure plasmas
- Plasma medicine
- Spectroscopic plasma and flame monitoring
- Application-related burner and electrode development
- Atmospheric pressure plasma application laboratory for customer and application-specific analyses

**Vacuum processes**
- Reactive sputtering and thermal evaporation
- Parylene coating
- Plasma-based fine cleaning and surface activation (e.g. polytetrafluorethylene [PTFE])
- Optical thin films
- Layers for self-cleaning and catalytic processes
- Gas-phase fluorination to modify surfaces (adhesion improvement, barrier)

### GALVANIC AND CHEMICAL DEPOSITION PROCESSES
- Corrosion protection of magnesium alloys by way of chemical passivation or plasma-chemical oxidation processes
- Plasma-chemical processes for the generation of black, temperature and radiation-resistant surfaces on light metals
- Plasma-chemical processes for the biocompatible equipment of titanium alloys
- Non-ferromagnetic chemical nickel coatings on non-conductive substrate materials
- Dispersion coatings on the basis of chemical nickel (chemical nickel plating)
- Electrochemical polishing of Fe and Cu-based alloys

### SOL-GEL-TECHNOLOGY
- Barrier layers against gas and water vapor permeation
- Corrosion protection coatings
- Non-stick, fluorescence, bactericidal and scratch-resistant coatings
- Photocatalytic coatings
- Easy-to-clean coatings


## PRIMER & CHEMICAL SURFACE TREATMENT

### FUNCTIONAL SURFACES
**SURFACE ACTIVATION**
- Activation of plastics with low surface energy (PE, PP, PA…) for bonding processes, coatings etc.
- Adapting the surface pretreatment to the particular compound system
- Combination of physical and chemical processes for improving the compound stability
- Adjustment of surface energy (hydrophily, hydrophobicity, oleophobia)
- Development of adhesion-promoting, easy clean coatings and anti-microbial or bactericidal surfaces
- Surface activation with ozone-generating UVC-radiation
- Silanization from the gas phase
- Electrochemical silicatization

### CORROSION PROTECTION
- Corrosion testing
- Biocorrosion
- Development/modification of corrosion protection coatings
- Corrosion phenomena in cooling circuits

### COMPOSITE SOLUTIONS
- Modification and complete formulation of coatings, adhesives and potting casting compounds
- Development of complete bonding, coating and casting technologies, also for difficult-to-bond materials
- Bonding and pickling agents for improving adhesion
- Adhesive and sealing agents for plastic hybrid technology, overmolding of glass, metal etc. with plastics
- Highly filled reactive compounds for special applications (deheating agents, highly abrasion-resistant epoxy compounds with extreme operation profile, expanding compounds etc.)


## MAGNETIC AND OPTICAL SYSTEMS

### COMPUTER SIMULATION
- Multiphysics simulations – FEM and analytical calculations
- Simulation of magnetic field configurations, of magnetic systems and optimization of magnetic components
- Computational Fluid Dynamics (CFD)
- Crystal growth on atomistic scale (MD simulation)
- Dislocation dynamics in poly- and monocrystals
- Optics of laterally structured layers

### MAGNET TECHNOLOGY
- Development of magnetic measuring systems (e.g. inline quality control)
- Magnetic field generation and characterization
- Active and passive magnetic field shielding
- Localization of magnetic dipoles
- Development of magneto-optical sensor systems for magnetic stray field visualization
- Characterization of magnetic properties

### OPTICAL MEASUREMENT SYSTEMS AND METHODS
- Microtopography measurement of technical surfaces (ripple, texture and roughness)
- Micro and macro twist analysis on shaft seal seats
- Layer characterization on glass surfaces
- Surface homogeneity measurements of float glass
- Quality assessment of optically transparent materials
- Simulation of diffraction and scattered light distribution on complex surface structures
- Prototype manufacturing for quality control

### LIQUID-PHASE-EPITAXY AND CRYSTAL GROWTH
- Epitaxial layers for magneto-optical imaging, microwave applications and spintronics
- Solution growth of singlecrystals (garnets, hexaferrites) for high-frequency applications
- Synthesis of nano-scale magnetic particles for medical and technical applications


## BIOMATERIALS
for medicine, pharmacy and biotechnology

### SYNTHESIS OF CUSTOMIZED POLYMERS
- Absorbable polyesters (polylactides, caprolactones and copolyesters) as well as polyurethanes
- Functionalized glycosaminoglycan's and polysaccharides (hy-aluronic acid, chondroitin sulfate, chitosan & dextran deri-vates)
- Biocompatible thermally and photo-chemically crosslinkable macromers
- Absorbable composites

### ACTIVE INGREDIENT SYNTHESIS
- Low-molecular substances
- Prodrugs
- Active ingredient conjugates

### SURFACE AND MATERIAL DESIGN
- Chemical surface modification (hydrophilization as well as introduction of biologically active groups and anchor functions)
- Highly porous three-dimensional networks and composites made of polymers and „bone-like" inorganic components
- Nano-structured and micro-structured types of fleece (electro-spinning), biodegradable hydrogels

### DEVICE PRODUCTION
- Temporary implants and bone substitute materials
- In-situ curable systems (adhesives and fillers)
- Implant coatings with the active substance(s) being integrated and drug delivery devices
- Anti-bacterial coatings
- Scaffolds for the cell cultivation (tissue engineering)
- Functional coatings of bio-sensor surfaces
- Functionalized nanoparticles

### BIOMATERIAL CHARACTERIZATION
- Substance and structure characterization
- Material testing (thermal/chemical/mechanical properties)
- In-vitro biodegradation
- Release behavior of active ingredients
- Biocompatibility (cytotoxicity tests, cell adhesion, ELISA tests, protein, DNA/RNA analytics)


## ANALYTICS AND MATERIAL TESTING

### CONSULTING AND ANALYTICAL SUPPORT
- Material, layer, particle & surface analyses
- Failure- and damage analysis
- Quality control

### ADHESIVES AND SEALANTS
- FEM simulation of adhesive bonds
- Formulation according to the requirement profile
- Material and composite properties

### VARNISHES AND COATINGS
- Functionality and permanence
- Corrosion protection
- Barrier behavior

### PLASTICS - INJECTION MOLDING, EXTRUSION, 3D-PRINTING
- Suitability test (e.g. for medical devices)
- Adhesiveness and paintability
- Early damage detection

### METALS
- Metal alloys
- Material specification
- Surface purity

### INNOVATIVE TEST METHODS
- Technical cotton swabs for surface analyses
- Shrink/stiffness measurement - stress-free bonding
- Measuring cell for quick permeation tests

## SCIENTIFIC INSTRUMENTATION

- Concept development and implementation suggestions
- Preparation of design documents
- Cost calculation
- Production of prototypes, assemblies and components (pilot series)
- Technical support during the transition to the production process and the application there




## SOLUTIONS

We can offer you research services to solve various issues and questions:

### SCALE-UP SYNTHESES
- Monomer and prepolymer synthesis
- Active substance synthesis and prodrugs
- Polymers, varnishes and adhesives, additives, dyes
- (Bio)material synthesis
- Biopolymer derivates and hybrid polymers

### POLYMER ANALYTICS
- Identification of plastics, varnishes & adhesives
- Quantification of polymers, additives & fillers
- Molar mass and molar mass distribution
- Determination of monomers, residual monomer content
- Determination of the degree of implementation & branching
- Copolymers, end group analysis
- Fogging/outgassing behavior
- Thermal and mechanical properties
- Analysis of organic residues on surfaces

### MATERIALS TESTING
- Determination of material parameters
- Corrosion tests
- Bonding strength tests
- Permeation tests
- Climate, weathering, alternating load and light resistance tests according to DIN
- High-speed adhesion tests
- Particle size measurements

### INNOVATIVE TECHNOLOGIES FOR THE PROTECTION OF CULTURAL ASSETS | FORUM INN-O-KULTUR
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### SURFACE CHARACTERIZATION
- Surface topography (structure, roughness)
- Contamination analyses
- Determination of optical properties of layers
- Qualitative or quantitative surface analyses
- Layer analyses (layer thickness, composition)

### MEDICAL DRUG AND MEDICAL DEVICE TESTING
- Release tests
- Method development and validation

### MAGNETIC MEASUREMENTS
- Determination of magnetic fields and materials
- Use of magnetic localization techniques

### DAMAGE ANALYSIS
- Investigation of damage cases in production
- Examination of customer complaints

### PROTOTYPE CONSTUCTION
- Development and design
- Construction of functional prototypes