Component manufacturing

- Metal powder injection molding plants (clamping force 20 t and 40 t)
- 2-component injection molding machine
- Single cavity injection molding
- Hot press (vacuum, inert gas, 1800°C)
- Uniaxial powder presses (up to 1000 t)
- Powder press for thermal compaction (125 t)
- Extrusion press (5 MN)
- Rapid prototyping systems for laser sintering of metals; conceptual models via 3D printing, including colors
- Cold chamber die casting machine (real-time control, clamping force 660 t)
- Hot chamber die casting machine (real-time control, clamping force 315 t)
- Sand casting
- Precision casting systems for Al, Cu, Fe and special alloys
- Pilot systems for production of metal foam components
- Microwave system
- Screen printing machine
- CNC milling machine for model production
- Hot wire cutting system
- Model production with lost-foam processes
- Casting system with lost-foam processes (Al, Cu and Fe alloys)
- Spark-plasma sintering system (up to 300 mm component diameter)
- Production line for partly automated component production

Microstructuring and nanostructuring

- Ink-jet printing technologies
- Aerosol-Jet® technology
- Dispensing methods
- Production line for partly automated microstructuring
- Micro-injection molding system
- Four-point bend station
- Ink test bench
- Sputter technology
- Glovebox system

Thermal/Chemical treatment of formed components

- Chemical dewaxing units for injection molded components
- Various sintering furnaces (up to 2000°C, inert gas, hydrogen, vacuum)

Material synthesis and processing

- Plants for manufacturing gradient materials (sedimentation, wet powder injection)
- Test stand for characterizing functional inks for ink-jet printing processes
- Melt extraction unit (metal fibers)
- Rapid solidification system (melt-spinning) for producing nanocrystalline or amorphous films or flakes
- Fast blender and shearing roller extruder for MIM-

1 Manufacture of battery test cells under inert conditions.
2 Electrochemical analysis of battery electrodes.
feedstock production
- Grinding technologies
- Twin screw extruder
- Compounding of biopolymers and composites
- Granulator

**Instrumental analytics**

- Rheometry
- Micro tensile testing machine
- Tensiometer
- 2D/3D laser surface profilometry
- Laser confocal microscope
- Electrochemical STM/AFM
- Hydrogen analytics
- Thermal conductivity measurements on molding materials
- IR laser for translucent material density determination
- Magnetic measurement technology
- Electrical characterization
- Dynamic sensor characterization
- FIB – Focussed Ion Beam for the in-situ preparation of cross-sections and TEM lamellae
- High resolution scanning electron microscopy (HRSEM) with cryo preparation chamber
- Resonance Frequency Damping Analysis (RFDA)
- Scanning electron microscope (SEM) with EDX analysis (accredited)
- X-ray fine structure analysis
- Thermal analysis with DSC, DTA, TGA, PCT
- Sinter/alpha dilatometry (accredited)
- Powder analysis technology with BET and laser granulometry (particle size analysis)
- Trace element analysis (H, C, N, O, S)
- Emission spectrometer
- X-ray tomograph (160 kV)
- Gas permeability determination

**Electrical Energy Storage**

- Battery and cell test stands (cycling unit)
- Impedance spectroscopy (30 μHz … 40 MHz)
- Laser microscopy
- Raman spectrometer with integrated AFM
- Thermal analysis with integrated MS/IR
- Glove box system with integrated PVD unit for electrode coating and production of battery cells

**Electromobility**

- Two motor test benches up to 120 kW
- Battery test stand up to 50 kWh
- Test vehicle for component testing
- Test stand for hydrogen storage systems

**Computer**

- High-performance workstations with software for nonlinear FE analysis, mold filling and solidification simulation, and component optimization

**New equipment acquired in 2012**

- Pixdro LP50 ink-jet printer
- Kuka robot system
- IPETRONIK FLEETlog data logger
- Wax injection molding machine
- Mathis laboratory coating plant KTF-S 350 roll-to-roll
- Simultaneous thermal analysis system (TG-DSC/DTA)
- Simultaneous ICP-OES spectrometer
ADHESIVE BONDING TECHNOLOGY AND SURFACES

Analytics

- 200 kV FEG transmission electron microscope with EDX, EELS, EFTEM, as well as 3D tomography plus cryo and heating options
- Focused Ion Beam (FIB) for in-situ preparation of cross-sections and TEM lamellae
- High resolution scanning electron microscope (HRSEM) with cryo-preparation chamber
- Confocal laser microscope
- Surface analysis systems: XPS, UPS, TOF-SIMS, AES, and AFM
- Laser-induced Fluorescence (LIF)
- Laser-induced Breakdown Spectroscopy (LIBS)
- XRF hand unit (x-ray fluorescence analysis)
- Inverse Gas Chromatography (IGC)
- Chromatography (GC-MS and pyrolysis GC-MS)
- Chemiluminescence for analysis of aging processes
- Thermal analysis (DSC, modulated DSC, DMA, TMA, TGA, torsion pendulum)
- MALDI-TOF-MS for protein and polymer characterization
- Light scattering for characterizing turbid dispersions
- Spectroscopic ellipsometry
- Thermography
- Laser-induced plasma spectroscopy (LIPS)
- IR, Raman and UV-VIS spectrometers
- IR-VCD spectrometer (Infrared Vibrational Dichroism)
- Rheology (Rheolyst AR 1000 N, ARE5 – Advanced Rheometric Expansion System)
- Equipment for measuring heat conductivity
- Dielectrometer
- Electrochemical impedance spectroscopy (EIS) and noise analysis (ENA)

- High-performance potentiostat, 30 V, 20 A
- High-performance potentiostat, 100 V, 20 A
- MultEchem™ potentiostat system with 4 independent Reference 600 potentiostats
- Ion chromatograph and auto-titration system
- Instruments for measuring contact angles
- Scanning Kelvin probe
- Phased-array ultrasound measuring device (Olympus OmniScan MX PA)
- Fluorescence microscope
- Bohlin Gemini 200 rheometer

Computer-aided simulation methods

- High performance cluster with a total of 240 computing nodes and high-speed interconnect
- High performance cluster with a total of 112 computing nodes
- Simulation applications: Gaussian®, Turbomole®, LAMMPS, Accelrys Materials Studio®, Scienomics MAPS®, Culgi multiscale modeling library®, COMSOL Multiphysics®

Test methods

- Tribometer in combination with nano-indentation
- Laser scanner for 3D measurement of components up to 3500 mm
- Universal testing machines up to 400 kN
- Units for testing materials and components under high rates
Mobile x-ray fluorescence analyzer for surface analysis of metals and plastics.

Customized aging protection for electronic components via local atmospheric pressure plasma coatings.
Mechanical joining techniques

- All-electric laboratory riveting machine with semi-automatic installation of one-piece and two-piece fasteners, C-frame construction with 1.5 m frame depth, maximum compressive force: 70 kN, drill spindle for speeds up to 18,000 rpm and internal lubrication as well as high speed workplace monitoring

Small pilot plant facilities | Material processing

- Hall for large structure assembly, 80 × 50 m², two 20 tonne cranes, 15 m height under crane hooks
- Laser-tracker for 3D measurements, range 80 m
- Laser-radar for 3D measurement of components, range 30 m
- Combined laser-scanner and laser-tracker for 3D measurement of components of length up to 30 m
- Modular 3D waterjet cutting plant, 6000 bar, with laser positioning and drilling unit for components of up to 3 m length, 2 m width, and 0.5 m height
- Test stand for machining FRP components of up to 13 m length and 6 m diameter using several robots simultaneously and for the development of effective process monitoring and efficient dust extraction; it comprises 3 calibrated 6-axis robots (Stäubli, ABB, KuKa) on 6 m linear axis and a stationary robot station
- Modular flexible assembly plant for large CFRP structures with 2 calibrated 6-axis robots on 15 m linear axis and automated tool change
- Test stand for regulating the shape and position of large components; it comprises 6 industrial robots with parallel kinematics and a precisely calibrated 6-axis robot on a 4 m linear axis
- 6 axis industrial robot, 125 kg bearing load, on additional linear axis, 3000 mm

New equipment acquired in 2012

- Sorption measurement unit
- Computer cluster
- Automatic evaluation unit for filiform corrosion samples
- Transmitted light microscope
- UV excimer laser
- 3D profilometer Plu Neox
- IR spectrometer with Raman module
- Spectrometer for chemiluminescence
- Electrodynamic fatigue testing machine E 3000 – ElectroPuls™
- Modular and versatile assembly plant
- Kuka Quanteck KR 240 R3100 ultra k – control module for system integration of measurement technology