



# SABANCI UNIVERSITY INTEGRATED MANUFACTURING TECHNOLOGIES RESEARCH AND APPLICATION CENTER

Sabancı  
Universitesi

SU | IMC SABANCI UNIVERSITY  
INTEGRATED MANUFACTURING TECHNOLOGIES  
RESEARCH AND APPLICATION CENTER



## “CREATING AND DEVELOPING TOGETHER”

SU IMC is an industrial-scale research, technology development, and application center offering design, analysis, prototyping, manufacturing and process development services in relation to composite materials, additive manufacturing and robotic manufacturing.

## INDUSTRIAL SCALE R&D

Built on 15,000 m<sup>2</sup> closed area with a 3,350 m<sup>2</sup> laboratory infrastructure, SU IMC is one of the very few research and application centers with a world-class manufacturing and testing facilities.

# VISION

Create high value-added integrated manufacturing and composite technologies.

# MISSION

Gain competent human power in the field of integrated manufacturing and composite material technologies in the ecosystem of university-industry collaboration, bring it to our local and global industry and academy.

Develop and make use of high technology with our collaborators with our open innovation principle.

## WHAT WE DO



### PROTOTYPING AND PRODUCT DEVELOPMENT

- Design, analysis and optimization services, prototype manufacturing, process and product development of composite and 3D products,
- Solutions with a high qualified research and engineering team,
- Consultancy and open innovation platform for the industrial partners to provide fast, reliable and value added solutions.



### RESEARCH AND APPLICATION

- Industrial-scale research and technology development center with well-known faculty members and researchers,
- Additive manufacturing and digital manufacturing technologies in the scope of multifunctional advanced composite materials and structures.



### MANUFACTURING AND TEST SERVICES

- Advanced composite and additive manufacturing, mechanical and material characterization, flammability and wet chemistry test services.



### PROFESSIONAL TRAINING

- Practical training of engineers and technicians by providing all aspects of Advanced Composites and Additive Manufacturing,
- Theoretical knowledge gained by participants will be practically supported by hands-on experiments.





## **COMPOSITE TECHNOLOGIES CENTER OF EXCELLENCE (CTCE)**

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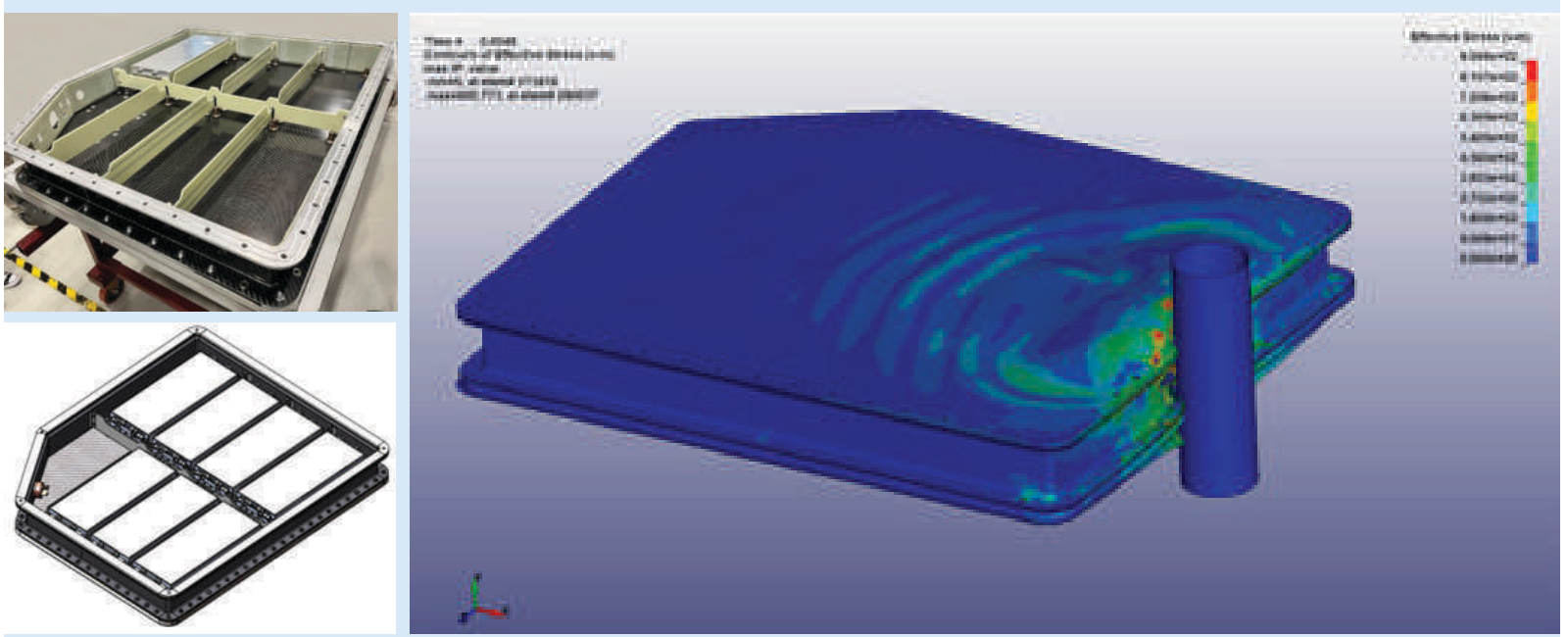
- Established as one of the most important research and technology development centers globally in composite materials.
- Combines industry and academia under the same roof. Researchers, designers, engineers, PhD students, postdoctoral fellows, faculty members and entrepreneurs co-exist in this ecosystem and get benefit from the interaction.
- Serves stakeholders by creating solutions depending on the customer's requirements.
- Covers all stages of the product development cycle including R&D, prototyping, commercialization and mass production.



# CAPABILITIES

## DESIGN AND ANALYSIS

Based on the customer needs, starting from the materials, method of manufacture, geometry, performance and the associated production cost, we provide high-quality design solutions.



We design and develop complete composite structural parts in the sense of styling of composite parts, mechanical analysis and manufacturing process.

We develop novel design methodologies in order to simulate various problems based on the demands of automotive, aerospace and defence industries.

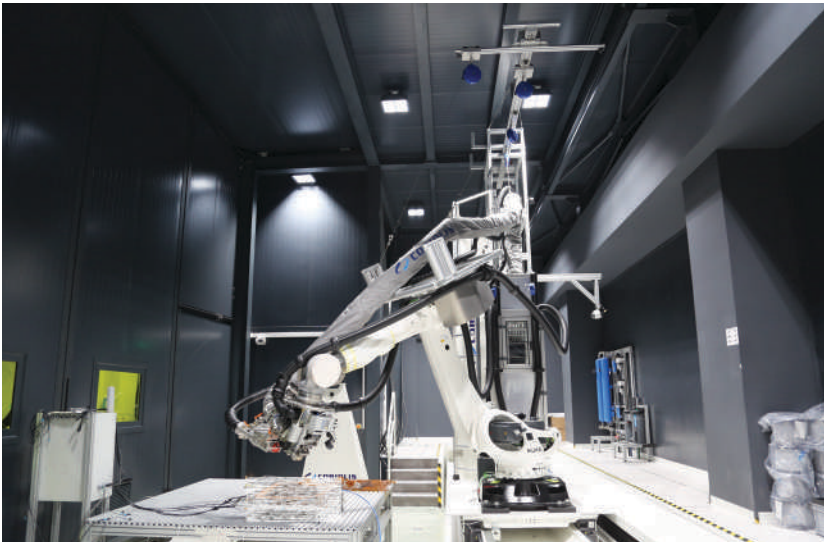
We provide simulation services to a wide variety of industrial problems including:

- Computer-Aided-Design (CAD) solutions,
- Detailed Structural Analysis (static and fatigue),
- Performance and failure analyses under various load conditions,
- Behaviour analyses including fatigue, creep and environmental effects,
- Dynamic crash simulations.

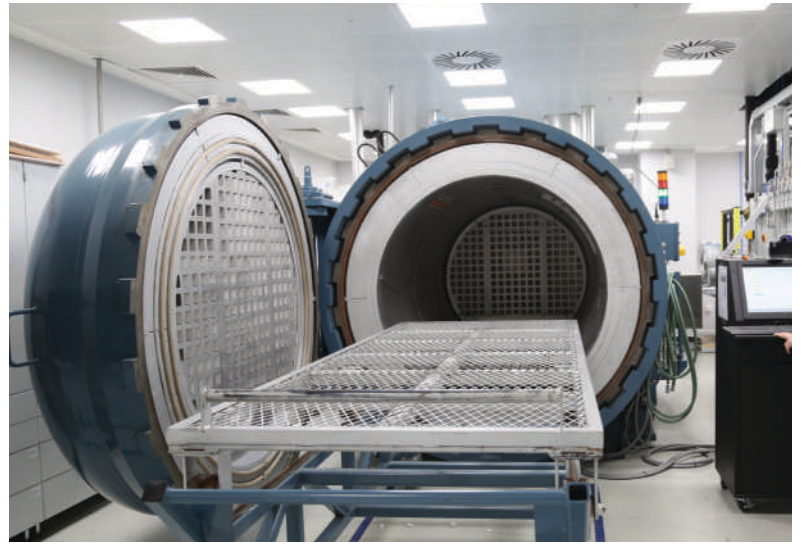
# ADVANCED COMPOSITES AND ROBOTIC MANUFACTURING

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High quality engineered composite parts can be produced for aerospace, defense, automotive and different industries utilizing both conventional and robotic based manufacturing technologies.



*Automated Fiber Placement (AFP) Machine is capable of thermoset and thermoplastic composite manufacturing.*

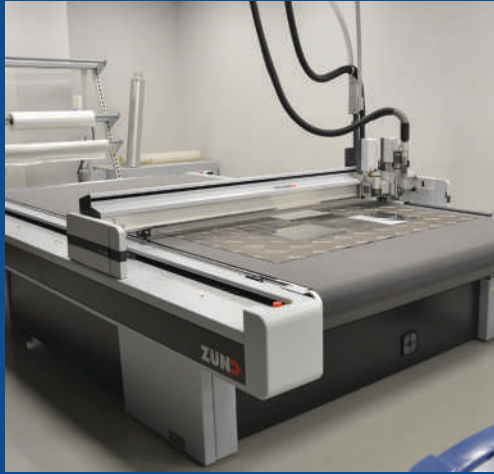


*Autoclave; Diameter 1.5Mt , Length 3.0 Mt  
Pressure 20 bar, Temperature up to 400°C*

- We investigate the simulation, development and application of advanced composite and robotic manufacturing processes encompassing both science and engineering aspects.
- We develop the use of reconfigurable manufacturing systems for SMEs and OEMs together with their cost and performance benefits. The facility is used for production of composite and metallic materials as well as testing services.
- We utilize Industrial Robotic Additive Manufacturing, Machining and Abrasive Waterjet Machining of composites and metals.
- The robotic machining and additive manufacturing cell can process both metals, thermoplastic and thermoset composites.



The facility is equipped with industrial-scale Autoclave, Hot Press, CNC-Machining Robot, Abrasive Waterjet Machining Robot and Wire EDM for composites and metals. In addition, large format additive manufacturing (LFAM) robot is available for polymer parts, molding and modelling.



Working Dimensions: 3000 mm x 1700 mm



Working Dimensions: 1200 x 1200 x 1200mm  
 Temperature : 450°C (±1°C)  
 Vacuum Pump: 40 m<sup>3</sup>/h, 720 mmHg



Dimensions : 500mm x 500mm  
 Pressure Force: 50 tons  
 Temperatura: 400°C



Large Format Additive Manufacturing (LFAM)



5-axis CNC Machining Robot and 2-axis Table top

Integration of industrial robotics with conventional and unconventional manufacturing processes leads the way to establish reconfigurable, cost-effective manufacturing systems enabling hybrid-manufacturing concepts.



*Dimensions: 1300 x 1040 x 500 mm<sup>3</sup>  
Wire travel in X-axis: 800 mm, Y-axis: 600 mm, Z-axis: 600 mm  
Maximum cutting speed: 450 mm<sup>2</sup>/min*



*5-Axis Abrasive Waterjet  
Pressure Up to 3750 bar*



Cutting composite materials requires specialized tools and techniques due to their unique composition. Common methods for cutting composites include abrasive water jet cutting, ICNC cutting, and diamond saw cutting. These methods ensure precision while minimizing damage to the material's integrity.



# ADDITIVE MANUFACTURING

Multifunctional complex metal and polymer parts can be manufactured fast and reliably with novel Additive Manufacturing Technologies.

- We develop new hybrid processes for manufacturing of complex parts.
- We improve and enhance existing processes.
- We focus on super-alloys and steel metals, high-performance plastics, composite and hybrid additive manufacturing processes.

Cold Spray, Electron Beam Melting Metal AM System (EBM), EOS M290 Selective Laser Melting Machine and DMG Mori Seiki Lasertec 65 3D Hybrid Process (Milling and Laser Deposition Welding) Machine are utilized for Metal Additive processes. In addition, vacuum H/T furnace, Dlyte surface improvement, ball mill system, sand-blasting, heat treatment and band-saw equipments are available for pre and post processes.



*Direct Energy Deposition (Ded) Additive Method  
Building Volume: 650 x 650 x 560 mm  
Laser Power: 3000W*



*Selective Laser Melting Additive Method (SLM)  
Construction Volume: 250 x 250 x 325 mm  
Laser power: 400 W*



## COLD SPRAY SYSTEM

Cold Spray is a method of coating or forming parts by spraying metal particles with high kinetic energy onto a substrate with high homogeneity and density. With this technology, thermal damages can be prevented and temperature sensitive materials can be coated. This feature makes Cold Spray technology unique compared to other production and coating methods.

- 1 cermet nozzle
- 1 ceramic nozzle
- 1 plastic nozzle
- Powder feeder (3+3 Lt)
- N<sub>2</sub>, N<sub>2</sub>+He supply available (inactive)
- Max. temperature: 1100 °C
- Max. pressure: 70 bar (He: 30 bar)
- Spray booth: 7.3 x 5 x 3.5 m<sup>3</sup>, sound insulation, steel frame
- Cold Spray gun Integrated to Robotic system (Kuka Robot + positioner = KUKA KR70 R2100 + DKP-400 V2)
- Maximum workspace size (robotic safe working area): 1m x 1m x 1m C



# ELECTRON BEAM MELTING

Electron Beam Melting (EBM) is a 3D manufacturing process in which a metal powder is melted by a high-energy electron beam. The electron beam melts the material by heating the entire powder bed for each layer to an optimum ambient temperature specific to the material used. As a result, parts produced by the EBM process contain almost no residual stress and have an optimum micro structure. Thanks to this method, high density metal parts can be produced, and layer-by-layer production allows to manufacture topologically-optimized, lightened parts with lattice structures.



*Powder bed temperature min. 1000 °C  
Beam Power: Variable 0-6 kW  
Build chamber: Ø100 x 210 mm H*

# VACUUM H/T FURNACE

Heat treatment is an important post-process for parts produced with metal additive manufacturing technologies. It is used for improving the mechanical of the part, ensuring the required surface hardness and wear resistance and reducing internal stress that may occur during additive manufacturing.



*Operating T max 1400 °C under vacuum  
Temperature sensitivity ±5 °C*

# POLYMER PROCESSING

Polymer Processing Facility offers the development of thermoplastic polymer compound formulations, masterbatch preparation and improved manufacturing processes.

Equipped with a twin-screw extruder with the capacity of up to 25 kg/h, a high shear compounding machine, an injection moulding, a film blowing system and two chemical reactors. Serving the customers in engineering plastics industry for novel monomer production and producing aviation thermoplastics such as PEEK, PEKK, PC, PEI, PA and PPS.

Provides the improvement of structural, thermal and mechanical properties of thermoplastic polymers and producing advanced functional composites based on industrial needs .



*Twin Screw Extruder,  
Temperature Up to 350°C  
Throughput 25kg/h*



*Blow Film Extruder*



*High Shear Compounding Mixer*

Provides the improvement of structural, thermal and mechanical properties of thermoplastic polymers and producing advanced functional composites based on industrial needs .

# MATERIAL CHARACTERIZATION LABORATORY

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Material Characterization Laboratory covers the thermal, thermo-mechanical, rheological and structural characterization of all composite materials and individual components used in composite manufacturing. The lab can characterize the thermal properties of materials by means of thermo-gravimetric (TGA), various differential scanning calorimetry (DSC, Flash DSC, HPDSC) and thermal conductivity measurements.

- Thermal stability and degradation behavior of materials (DSC, TGA)
- Thermal transition of materials under controlled, variable heating and cooling rates
- Thermo-mechanical behavior of materials under load (DMA)
- Rheological behavior of materials under variable shear or temperature
- Thermal conductivity of materials
- Molecular weight analysis of polymers and oligomers
- Heat deflection temperature (HDT)
- Contact angle of liquids on surfaces
- Surface analysis via Stereo Zoom Microscopes
- X-Ray Diffraction Analysis Equipment
- Hardness Test Equipment
- Tribometer
- Scanning Electron Microscope (SEM) with Focused Ion Beam







Magnification range: 12x – 2.000.000x  
 Working distance range: 1 to 50 mm  
 FIB (Focused Ion Beam), EDS (Energy Dispersive X-ray Spectroscopy) and EBSD (Electron Backscatter Diffraction) analysis  
 Holder capacity: 9 for appropriately sized specimens  
 Lenses: in-lens SE, in-lens BSE, SE2

**SEM (Scanning Electron Microscope)**

Cu X-ray tube  
 5-axes Eulerian cradle sample stage with programmable X, Y, Z, Chi Phi movements  
 Detector pixel size max 75  $\mu\text{m}$   
 0D, 1D, 2D measurement capability  
 sample holders also for irregular samples and powder analysis  
 Program input capability of min. 0.001 mm increments  
 Configuration: Vertical Theta/2Theta and Theta/Theta geometry  
 Scanning angular range:  $-110^\circ < 2\theta < +168^\circ$  (depends on accessories)  
 Angular accuracy: Better than  $\pm 0.01^\circ$  over the whole 2-Theta range  
 Smallest selectable step size:  $0.00001^\circ$   
 Focus: 0.4 x 12 mm LFF (Long Fine Focus)  
 Detectors: Scintillation counter, Celerix 1D/2D multi strip detectors Silicon Drift Detectors (SDDs)



**X-Ray Diffraction (XRD)**



### Hardness Tester

Load capacity range: 0.25 g – 62.5 kg  
Vickers: DIN EN ISO 6507, ASTM E384, ASTM E92  
Knoop: DIN EN ISO 4545, ASTM E384, ASTM E92  
Brinell: DIN EN ISO 6506, ASTM E10  
5 MP integrated high resolution camera  
2.5X - 100X lenses  
Traverse path of X/Y axes 120 mm x 120 mm

Rotary (pin-on-disc) module: Rotary disc maximum dia 60 mm, slide diameter range 0-30 mm  
Linear (reciprocating) module: 25 x 50 mm<sup>2</sup> table  
Lubrication module  
High temperature test module (test temperatures from RT to 400 °C, step size 4°C), maximum sample diameter 10-20 mm  
Measurement sensitivity: 2 µm



### TRIBOMETER

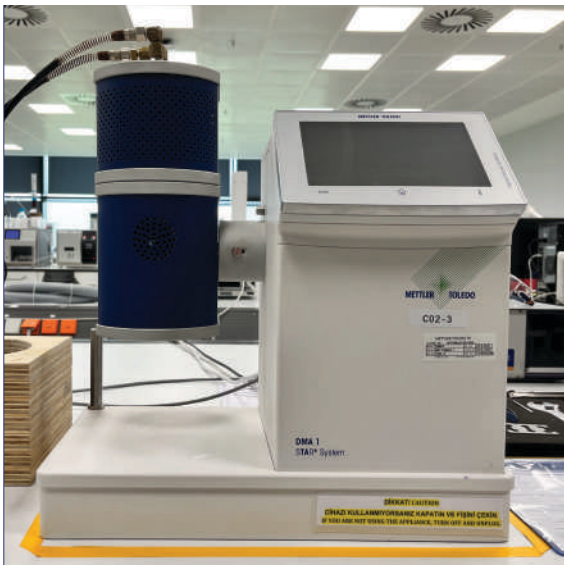


**METTLER TOLEDO DMA/STDA 861E**

*Measures the mechanical properties of materials as a function of time, temperature, and frequency.*

ASTM D7028  
 ASTM D4065  
 ASTM D4473  
 ASTM D5024  
 ASTM D5056  
 ASTM D5023

- Temperature range: -150 °C to 500 °C
- Working temperature range: -100 °C to 450 °C
- Force range: 0.001 N to 40 N
- Measurement modes: Bending, tension, compression (max 300 Hz), shear (max 1000 Hz)



**METTLER TOLEDO DMA 1**

*Measures the mechanical properties of materials as a function of time, temperature, and frequency.*

ASTM D7028  
 ASTM D4065  
 ASTM D4473  
 ASTM D5024  
 ASTM D5056  
 ASTM D5023

- Temperature range: -150 °C to 600 °C
- Working temperature range: -100 °C to 450 °C
- Force range: 0.001 N to 10 N
- Frequency range: max 300 Hz
- Measurement modes: Bending, tension, compression, shear





ASTM E793  
 ASTM E794  
 ASTM D3895  
 ASTM E1269  
 TS EN ISO  
 11357  
 (1-2-3-4-5-6-7)

- Temperature range: -150 °C to 700 °C
- Working temperature range: -100 °C to 450 °C
- Heating rate (RT to 700 °C): 0.02 K/min to 300 K/min
- Cooling rate: 0.02 K/min to 50 K/min
- Sensor type: FRS 6+ (HSS 9+)
- Special modes: ADSC, IsoStep™, TOPEM®
- Sample robot: 34 sample positions

Glass transition temperature and step height, temperature and enthalpy of melting and crystallization, specific heat capacity, characteristic reaction-cure temperatures and times, enthalpy of reaction and degree of conversion, oxidation induction time and temperature, crystallization kinetics.

**METTLER TOLEDO DSC 3+**



custom demand

- Temperature range: -85 °C to 400 °C
- Cooling rate: 6 K/min to 2400000 K/min
- Heating rate: 6 K/min to 3000000 K/min
- Sensor type: UFS 1 (standard)
- Number of thermocouples: 16
- Signal time constant : 1 ms (USF 1)
- Option: Microscopy

Study thermally induced physical transitions and chemical processes, processes involving the formation of structure in materials, direct measurement of rapid crystallization processes, investigation of the mechanism of action of additives under near-production conditions, comprehensive thermal analysis of materials in a very short time, analysis of very small sample amounts, determination of data for simulation calculations.

**METTLER TOLEDO Flash DSC**



ASTM D5885  
 ASTM D5483  
 ASTM D6186

- Pressure range: 0 MPa to 10 MPa
- Temperature range: RT to 700 °C
- Working temperature range: RT to 450 °C
- Sensor type: FRS 6+ (HSS9 +)

Study DSC measurements under increased pressure for material testing, process development or quality control, curing of resins (e.g. polycondensation reactions), curing reactions of polymers and oxidation stability

**METTLER TOLEDO HP DSC 2+ (HP DSC)**



ASTM E831  
 ASTM E1545  
 ASTM E228  
 TS EN 2155-12  
 TS ISO 11359-2

- Temperature range: -150 °C to 600 °C
- Working temperature range: -100 °C to 450 °C
- Force range: 0.001 N to 10 N
- Frequency range: max 300 Hz
- Measurement modes: Bending, tension, compression, shear

Measurement of expansion coefficients.

**METTLER TOLEDO TMA STDA1+**

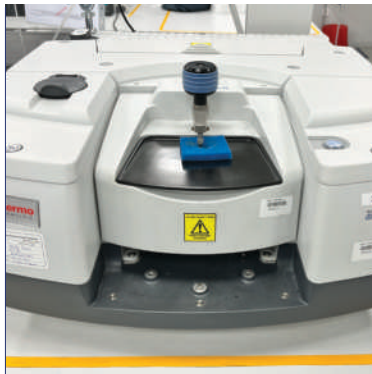


**METTLER TOLEDO  
TGA/DSC 3+**

ASTM d5805  
ts en iso  
11358-1

- Simultaneous DSC heat flow measurement
- Temperature range: RT to 1600 °C
- Working temperature range: RT to 1100 °C
- Heating rate: 0.02 K/min to 150 K/min
- Dynamic weighing range: 1 g
- Weighing accuracy, precision: 0.005 %, 0.0025 %
- Sample robot: 34 sample positions

- TGA: Quantitative content analysis, sublimation, evaporation and vaporization, thermal stability, oxidation reactions and oxidation stability, identification of decomposition products, identification of decomposition products, reaction and transition enthalpies
- DSC: Glass transitions, melting behavior, crystallization, heat capacity



**THERMOFISHER SCIENTIFIC  
NICOLET™ IS50**

ASTM e1252  
en 6042

- Smart iTR with Diamond and GE plate
- Specac Complete KBr Pellet Prep Kit
- 15 ton manual hydraulic press
- Pellet holder, pellet die
- Aldrich FTIR research library
- Software: OMNIC

Fourier Transform Infrared Spectroscopy (FTIR), analysis is an analytical technique used to identify organic, polymeric, and in some cases, inorganic



**ANTON PAAR  
MRC 702 TWIN DRIVE**

ASTM d5279  
astm d4440  
en iso 6721-10

- Temperature range (peltier): 0 °C to 200 °C
- Temperature range (furnace): RT to 450 °C
- Maximum torque: 200 mNm
- Maximum angular frequency: 628 rad/s
- Maximum speed: 3000 rpm
- Normal force range: -50 N to 50 N
- Test atmosphere: Air, Nitrogen

Composite, resin, rubber, thermoplastic, thermoset, elastomer. Amplitude sweep, frequency sweep, temperature sweep, viscosity, (storage, loss, damping), gel time and isothermal measurements. Solid rectangular fixture (SRF) in torsion is a thermal analysis technique for determining glass transition, frequency sweep, isothermal measurements.



**ANTON PAAR  
MRC 302 TWIN DRIVE**

ASTM d5279  
astm d4440  
en iso 6721-10

- Temperature range (peltier): 0 °C to 200 °C
- Temperature range (furnace): RT to 450 °C
- Maximum torque: 200 mNm
- Maximum angular frequency: 628 rad/s
- Maximum speed: 3000 rpm
- Normal force range: -50 N to 50 N
- Test atmosphere: Air, Nitrogen

Composite, resin, rubber, thermoplastic, thermoset, elastomer. Amplitude sweep, frequency sweep, temperature sweep, viscosity, (storage, loss, damping), gel time and isothermal measurements.



ASTM 3530  
EN 2330  
EN 2558

- Temperature: max 300 °C

Determination of volatiles content of composite material prepreg, moisture absorption, conditioning, drying

**POL-EKO APARATURA SLW 115 STD DRYING OVEN**



ASTM D2584  
TS 1177  
EN ISO 1172  
EN 2564  
ASTM D3171-B

- Maximum temperature: 1200 °C
- Maximum working temperature: 1150 °C
- Inner dimensions (H x W x D): 28 x 28 x 35

Constituent content of glass fiber reinforced composites, ignition loss of cured reinforced resins, void content of reinforced plastics, constituent content of composite prepreg (fiber content, fiber areal weight and matrix content by matrix burn-off)

**PROTHERM PLF 120/27 ASH FURNACE**



TS EN ISO 3219  
ASTM D4287  
ISO +A19  
B192884  
BS 3900

- Cone Spindle: 1,3,6
- Viscosity range: 0.2 Poise to 15,000 Poise
- Temperature range: 50 °C to 235 °C
- Shear rate: 10 s<sup>-1</sup> to 13,000 s<sup>-1</sup>
- Speed rate: 5 rpm to 1000 rpm
- Sample size less than 1 mL
- Software: Capcalc32

Viscosity measurements for composite polymers, resins, paint, gels, gums, food products.

**BROOKFIELD CAP 2000+ VISCOMETER**



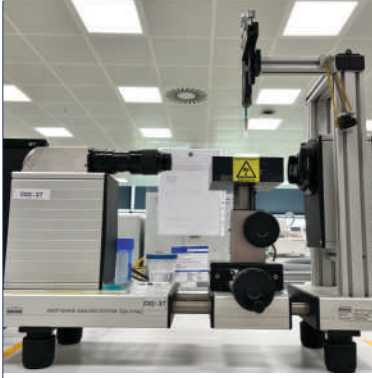
TS EN ISO 1183-1  
TS EN ISO 1183-3  
ISO 10119

- Gas type: Helium (He)
- Sample cell types and nominal volumes:
- Micro cell (4.25 cm<sup>3</sup>), Meso cell (1.75 cm<sup>3</sup>), Nano cell 0.25 cm<sup>3</sup>

Determination of true volume and true density,

**QUANTACHROME MICRO-ULTRAPYC 1200E**





**KRÜSS DSA 10-MK2  
DROP SHAPE ANALYSIS SYSTEM**

INTERNAL  
/CUSTOM  
DEMAND

- *Methods: Tangent method, H/W method, Circle fitting.*
- *Manual syringe, camera, light source.*
- *Temperature: room temperature.*
- *Liquid: water*

Contact angle,  $\theta$  (theta), is a quantitative measure of wetting of a solid by a liquid.



**POL-EKO APARATURA  
KKS 240 IG SMART PRO**

EN 2743  
ISO 291  
ISO 618

- *Temperature range: 0 °C to 100 °C*
- *Temperature resolution: 0.1 °C*
- *Relative humidity range: 10 % to 90 %*
- *Relative humidity resolution: 1.0 %*

Conditioning, drying,  
moisture absorption



**SHIMADZU LC-2040-C PLUS  
(HPLC)**

EN 6040

- *Detector: Shimadzu SPD-M20A Diode Array Detector*
- *Maximum pressure: 66 MPa, 44 MPa, 22 MPa*
- *Configuration: Four-solvent low-pressure gradient*
- *Temperature control: max 90 °C*
- *Wavelength range: 190 nm to 800 nm*
- *Light source: Deuterium (D2) lamp (Standard), tungsten (W) lamp*
- *Injecton volume range: 0.1  $\mu$ l to 100  $\mu$ l*

Epoxy resins, prepregs



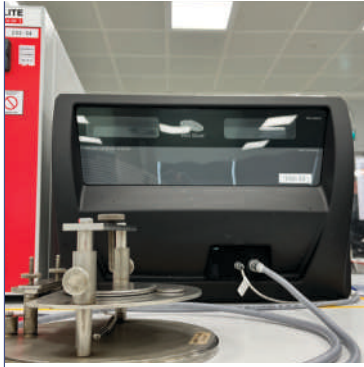
**INSTRON CEAST HDT VICAT HV3  
HDT**

**HDT:**  
ASTM D648  
TS EN  
ISO 75-1, 2, 3

**VICAT:**  
ISO 306\*  
ASTM D1525\*

- *Temperature range: 25 °C to 300 °C*
- *Vicat Method A: 10 N*
- *Vicat Method B: 50 N*
- *HDT Method A: 1.8 N/mm<sup>2</sup>*
- *HDT Method C: 8.0 N/mm<sup>2</sup>*
- *Testing stations: 3*

Thermo-mechanical systems are used to characterize the behavior of plastic materials at high temperatures, measuring the heat deflection temperature (HDT) and the Vicat softening temperature (Vicat).



**HOTDISK - TPS 2500S  
THERMAL CONDUCTIVITY ANALYSIS**

ISO 22007-1, -2

- Thermal conductivity: 0.005 to 1800 W/m/K
- Thermal diffusivity: 0.01 to 1200 mm<sup>2</sup>/s
- Thermal effusivity: 20 to 55000 W√s/m<sup>2</sup>/K
- Specific heat capacity: Up to 5 MJ/m<sup>3</sup>/K
- Reproducibility: Typically better than 1 %
- Temperature range: -60 °C to 180 °C
- Sensor: 300 °C, -60 °C - 180 °C, Cp gold cell

Analysis of thermal transport properties - including thermal conductivity, thermal diffusivity and specific heat capacity



**SOLVENT AUTO EXTRACTOR**

INTERNAL/  
CUSTOM  
DEMAND  
EN 2329  
EN 2331  
EN 2557

- Positions: 6-positions
- Temperature range: RT to 300 °C
- Measuring range: 0.1 % - 100 %
- Automation: Immersion, Removing, Washing, Recovery, Cooling
- Solvent recovery: > 90 %
- Water consumption: From 1.0 l/min

Determining resin, fiber and/or fiber areal weight of prepregs (FAW), fiber desizing



**MALVERN VISCOTEK GPCMAX  
GEL PERMEATION CHROMATOGRAPHY**

INTERNAL/  
CUSTOM  
DEMAND

- Solvent: DMF, Detector: RI, Light Scattering, Viscometer
- Detector module temperature: 55 °C
- Method: Light Scattering detector, Conventional Calibration method (PMMA based evaluation), Triple Detection determined MW, intrinsic viscosity, hydrodynamic radius measurement
- Column calibration range: 600 Da to 2730000 Da

Measurement of absolute molecular weight, molecular size, intrinsic viscosity, branching and other parameters.



**KSV INSTRUMENTS SIGMA 700  
TENSIOMETER**

INTERNAL/  
CUSTOM  
DEMAND

- Balance measuring range: 1 mN/m to 2000 mN/m
- Density: max 2.2 g/cm<sup>3</sup>
- Density resolution: 0.0001 g/cm<sup>3</sup>
- Maximum load: 210 g
- Force resolution: 0.1 μN
- Temperature control range: -20 °C to +200 °C

Surface tension (Wilhelmy plate methods), Critical Micelle Concentration (Wilhelmy plate methods) Density (density probe)



INTERNAL  
/CUSTOM  
DEMAND

- Optical:Objectives: CFI TU Plan FLUOR BD 2.5X, 5X, 10X, 20X, 50X
- Camera: Clemex 1.3 Mp, (1280 x 1024) pixels, Color
- Software: Vision Lite for Image Analysis - Clemex
- Stereo:Objectives: Plan 1X
- Camera: Clemex 1.3 Mp, (1280 x 1024) pixels, Color
- Software: NIS-Elements D

Measuring the void content, particle size, coating thickness. Before having image analysis, cold molding and metallographic sample preparation.

OPTICAL & STEREO MICROSCOPE

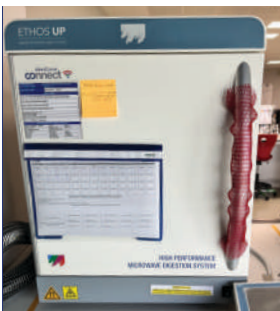


INTERNAL  
/CUSTOM  
DEMAND

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- Software: NIS-Elements D

Measuring the void content, particle size, coating thickness. Before having image analysis, cold molding and metallographic sample preparation.

OPTICAL & STEREO MICROSCOPE



ASTM D3171 (F)

- The microwave cavity has a volume of over 70 liters
- Two 950 Watt magnetrons for a total of 1900 Watt
- Infrared sensors combined with an in-situ temperature sensor
- Digestion rotors: SK-15, MAXI-44, MAXI-24 HP

Acid digestion, determining constituent content of carbon composites

MILESTONE CONNECT ETHOS UP  
HIGH PERFORMANCE MICROWAVE  
DIGESTION SYSTEM



ASTM D3171 (B)  
EN 2564

- Maximum temperature: 450 °C
- Power: 720 W
- Bottle dimensions: 500 ml x 3

Acid digestion, constituent content of composite materials (carbon fiber reinforced composites)

WITEG WHM-12391  
HEATING MANTLE



# MECHANICAL TESTING AND STRUCTURAL HEALTH MONITORING LABORATORY

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Mechanical properties of all kinds of materials are characterized and reported in accordance with international standards, accredited testing services. We provide testing services by using our state-of-the-art testing capabilities coupled with experienced professionals in the field.

Metallic and non-Metallic Materials Properties Development and Standardization (MMPDS) data, Design Allowables (DA), Fatigue and Damage Tolerance (F&DT) characteristics are provided.

Quasi Static and Dynamic (Fatigue, Torsional) Tests are held at 100kN and 250kN load cell capacity Universal Testing Machines coupled with temperature chambers (-100°C +400°C). Materials under stress are observed via DIC camera system for strain mapping and extensometer, video-extensometer and strain gauges for strain measurements.



# UNIVERSAL TEST MACHINE

## MECHANICAL PROPERTIES

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### INSTRON 1

10N, 5kN and 100kN Load Cell Capacity  
Quasi Static Tests  
Heating Chamber Tests at  $-100^{\circ}\text{C}$  and  $+350^{\circ}\text{C}$   
Strain Gauge, Contact Extensometer



### INSTRON 2

100kN Load Cell Capacity  
Quasi Static Tests  
Heating Chamber Tests at  $-90^{\circ}\text{C}$  and  $+350^{\circ}\text{C}$   
Strain Gauge, Contact Extensometer





### **INSTRON 3**

*250kN Load Cell Capacity  
Dynamic and Quasi Static Tests  
Fatigue Tests  
Heating Chamber Tests at -150 ° C and +350 ° C  
Video Extensometer, Strain Gauge, Contact  
Extensometer*



### **INSTRON 4**

*250kN Load Cell Capacity  
Dynamic and Quasi Static Tests  
Fatigue Tests  
Torsional Tests  
Heating Chamber Tests at -150 ° C and +500 ° C  
Strain Gauge, Contact Extensometer*



# CLIMATIC CABINET AGING AND CONDITIONING



VÖTSCH VC3 71500



VÖTSCH CLIME EVENT  
C/1500/70/3

*Tests for the aging and moisture retention capabilities of the materials  
Temperatures between  $-70^{\circ}\text{C}$  and  $+180^{\circ}\text{C}$ , Humidity levels between 10% and 98%  
Aging can be carried out under UV light exposure.*



### Zwick-Roell Vibrophore 100 High Cycle Fatigue Tester

Maximum load capacity: 100 kN, Test frequency range: 30-285 Hz  
 Test standards: ASTM E466  
 Grips for M10 and M12 threaded specimens  
 Test temperature max. 1100 °C  
 Tensile test without extensometer at high temperature  
 Only load-controlled tests



### Raagen ETM 100 S1 Creep Tester

Maximum load capacity:  $\pm 100$  kN  
 speed range: 0.001 - 100 mm/min  
 Temperature range: 200 - 1100 °C  
 Conducting tests up to 10 000 hours  
 Grips for M10 and M12 threaded specimens  
 Tensile test with or without extensometer at high temperature  
 Test standard: ASTM E139  
 Both load and strain-controlled tests

# IMPACT DEVICES

## IMPACT ENERGY MEASUREMENTS

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**INSTRON CEAST 9050**  
PENDULUM IMPACT DEVICE

*Impact tests on notched or non-notched materials.*

*Pendulum Impact Energy 1J to 50J*

*Charpy, Izod and Tensile Impact Tests*



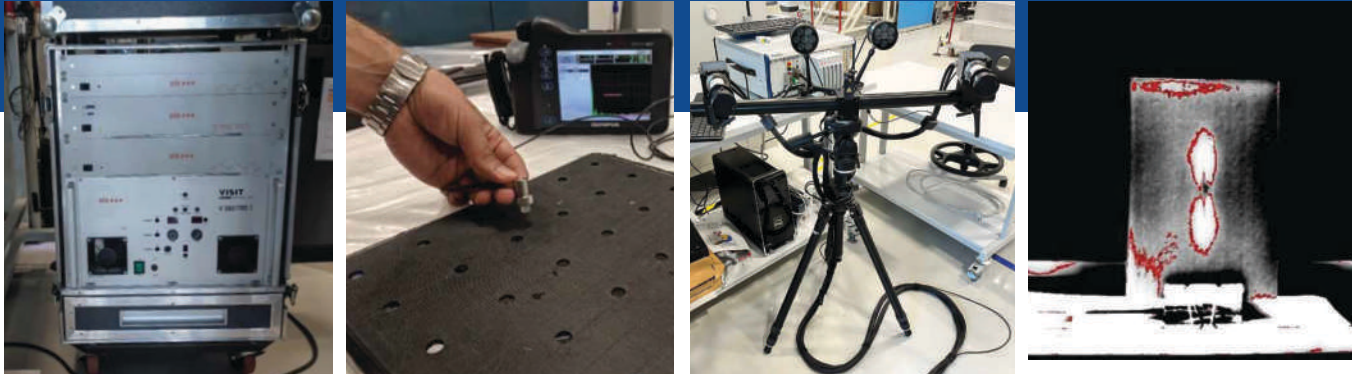
**INSTRON 9400**  
DROP TOWER TEST MACHINE

*Drop Tower Impact Energy 0.3J to 1800J*

*The purpose of using it is to cause damage on the surface of samples like compression after impact test.*

*Compression After Impact Tests*





# NON-CONTACT MEASUREMENT TECHNOLOGIES STRUCTURAL HEALTH MONITORING

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## ACOUSTIC EMISSION ANALYSIS, NDT, DIC STRAIN MEASUREMENTS

*Quantitative measurements of the shape,  
displacement, and strain of test objects*

*Acoustic Emission Analysis*

*Thermal NDT*

*High-resolution Digital Image Correlation (DIC),  
thermography, acoustic emission and Fiber*

*Bragg Grating (FBG) based sensors.*

*Ultrasonic Immersion Tank*

*X-Ray Computed Tomography (X-CT)*



**TECHNITEST-TRITON**  
**Ultrasonic Immersion Test System**

1500 x 1000 x 1000 mm<sup>3</sup> tank size  
 A-scan, B-scan, C-scan capability  
 Pulse width range: 50 ns - 500 ns  
 Double Transmission, Through  
 Transmission, Pulse-Echo Scan, Gimball  
 Scan for slightly curved surfaces  
 Motorized Turntable for discs and small  
 cylinders (maximum diameter 50 - 400  
 mm)  
 4 motorized axis system (X, Y, Z, U)  
 Phase Array Inspection  
 Metallic and nonmetallic specimen  
 inspections



**VTOMEX-M300-GE**  
**X-Ray Computed Tomography**

Detail detectability > 1  $\mu\text{m}$  with a  
 microfocus tube and > 0.6  $\mu\text{m}$  with a  
 nano-focus tube, offering industryleading  
 magnification for highly  
 absorbing samples  
 With a maximum voltage/power of 300  
 kV/500 W for the Microfocus and 180  
 kV/20 W for the high-power nano-focus  
 tube  
 Max. sample size of up to  $\text{\O}500 \times 800$   
 mm in height (scanning area max.  $\text{\O}290$   
 $\times 400$  mm height)  
 Extremely fast CT data acquisition with  
 up to 30 fps and >10000:1 dynamic range  
 High measurement accuracy ( $\text{SD} (\mu\text{m}) \leq$   
 $(3.8 + L (\text{mm}))/100$ )  
 Optional Dynamic detector 410 x 410  
 mm (16" x 16"), 100  $\mu\text{m}$  pixel size, 4048  
 $\times 4048$  pixels (16 MP) for doubled CT  
 resolution

**Ultrasonic Immersion Tank**

# INTEGRATED MANUFACTURING TECHNOLOGIES RESEARCH AND APPLICATION CENTER

TESTING CAPABILITIES





## WET CHEMISTRY LABORATORY

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Equipped with several utilities for experiments from the production of newly designed monomers and nanomaterials to polymer synthesis. The utilities in the lab bring innovative solutions in the field of textiles, hygiene, household goods, automotive, aerospace and energy.

- Nanomaterials are synthesized by applying wet chemistry techniques, catalytic growth and core-shell electrospinning technology.
- Surface functionalization is performed to get better interfacial interactions between nanomaterials and the chosen matrix.
- Multi-functionality is provided to different surfaces such as fabrics, metals and ceramics.
- Nanomaterials (graphene, CNTs and HNTs) can be synthesized and incorporated into resins or thermoplastics.

## FLAMMABILITY TESTING LABORATORY

Offering flammability testing service according to aerospace and railway industry standards which require detailed and sensitive handling and execution. Moreover, textiles, foams, construction materials, engineering plastics and polymers can be tested per related standards of each industry. Comply with ASTM, ISO, FAR, EN45545, UL-94, BOEING, AIRBUS standards.

Facility is equipped with,

- Cone calorimeter
- Smoke Density and Toxicity Chamber
- Limiting Oxygen Index
- Multipurpose Burner Tester



# FLAMMABILITY LABORATORY EQUIPMENTS



LIMIT OXYGEN INDEX

Min. amount of oxygen to ignition

- EN 45545-2
- BS 2782 PART 1
- NES 715
- ISO 4589-2
- ISO 4589-3
- ASTM D 2863



MULTIPURPOSE BURNER TESTER

FAA vertical, horizontal, 45 and 60 degree Bunsen burner tests

- UL 94
- FAR PART 25.853 APPENDIX F PART I
- AITM 2.0002A
- AITM 2.0002B
- AITM 2.0003
- BOEING BSS 7230 F1
- BOEING BSS 7230 F2
- BOEING BSS 7230 F4



CONE CALORIMETER

- ASTM E 1354
- ISO 5660 PART1&2
- ASTM E 1550
- ASTM E 1740
- ASTM D 5485
- ASTM D 6113
- CAN ULC 135
- BS 476 PART 15
- NFPA 271
- AS/NZS 3837
- EN 45545-2

Heat release rate,  
Time to ignition,  
Mass loss rate,  
Smoke release rate,  
Effective heat of combustion,  
Rate of release of combustion



SMOKE DENSITY AND TOXICITY

- ISO 5659-2:2012
- NFPA 258
- FAR PART 25.853 APPENDIX F PART V
- AITM 2.0007
- AITM 3.0005
- BOEING BSS 7238
- BOEING BSS 7239
- EN 45545-2

Specific optical density under flaming and non-flaming conditions,  
The extraction of toxic gas measurement

# DIRECT DIGITAL MANUFACTURING PLATFORM (DIMAP)

The aim of the Platform is to develop additive manufacturing processes supported by smart production systems, direct manufacturing of complex and functional products, provide training, consultancy and prototypes on "Digitalization and Additive Manufacturing" and provide transformation and support for Target Groups to reach EU standards.

Target groups are SMEs, Start-Ups, Companies, Institutions, Universities, R&D and Design Centers.

The list of equipments;

1. Electron Beam Melting Metal Additive Manufacturing System (**Freemelt One**)
2. Cold Spraying System (**Dycomet - Titomic**)
3. Tube Furnace (**Nabertherm**)
4. CNC Lathe (**DMG MORI-CLX 350**)
5. Ball Mill System (**Fritsch**)
6. X-Ray Diffraction Analysis Equipment (**GNR EXPLORER**)
7. Microstructure Specimen Preparation Equipment (**STRUERS**)
8. Hardness Test Equipment (**QNESS HARDNESS TEST**)
9. Creep Tester (**RAAGEN**)
10. Tribometer (**UTS TRIBOLOG**)
11. Three Dimensional (3D) Scanner (**SMART SCAN-R12**)
12. Ultrasonic Immersion System (**TECHNITEST-TRITON**)
13. Scanning Electron Microscope (SEM) with Focused Ion Beam (**ZEISS-CROSSBEAM 350**)
14. X-Ray Computed Tomography (CT) (**VTOMEX-M300-GE**)
15. Fatigue Tester (**ZWICK-VIBROPHORE 100**)

## Platform Partners



\* Instrument for Pre-Accession (IPA), EU supported project





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