

Technological Laboratories for Advanced Processes and Materials (LTMA)

Type of Infrastructure

The Technological Laboratories for Advanced Processes and Materials have equipment for automated fiber deposition, controlled infiltration of polymeric resins, autoclave cure, metal additive layer manufacturing, chemical-physical and microscopic characterization, static and dynamic mechanical tests and non-destructive testing on typical aerospace materials.

The laboratories actively participate in several EU and MUR funded projects.

Main technical features

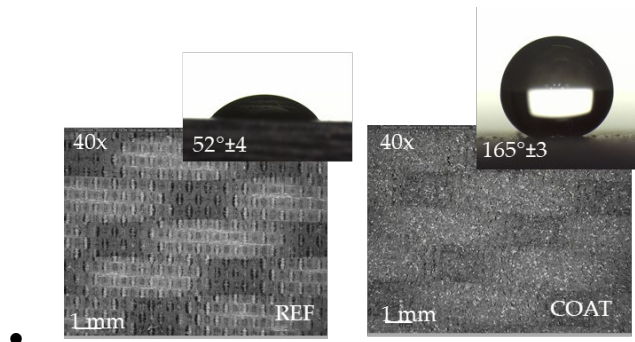
- Automated manufacturing process area
 - Autoclave IROP: Tmax 350°C and Pmax 8bar
 - Filament Winding (Wet e Dry) with 6 d.o.f and external axis 3000mm and diameter 800mm
 - Kuka Robotic Cell 7 d.o.f, for the robotic winding (Wet e Dry) with an external axis up to 6 Tons and deposition head developed in house with 8 tensioned bobbins/tows,
 - Hot Press for thermoplastic Compressione molding, Tmax 450°C, Pmax 40Bar



Filament winding machine

- Development and characterization of multifunctional materials and coating
 - Nanoparticles dispersion: Sonicator (Sonica Q700 700W), Three Roll milling (Exakt 80E), magnetic agitator
 - Equipment for coatings' application (Spray hood and Aerograph)

- Instrumentation for the surfaces' characterization: SAMA SA6260 surface roughness meter, microscope USB Dino-Lite AM4815ZTL, contact angle set-up; Cutting and tape tester for Paint Adhesion Gardco P-A-T; PosiTector Advanced probe to measure the coatings' thickness for metallic and non-metallic substrates.



Optical microscopy and measurement of contact angle, surface free energy and work of adhesion

- Manufacturing line: Autoclave IROP Tmax 350°C, Filament Winding (Wet e Dry) 6 d.o.f, Kuka Robotic Cell 8 d.o.f, Hot Press Tmax 450°C,
- Microscopy and thermo-chemo-rheological line : ESEM, Optical Microscopy, MDSC (-180C + 600÷°C); TGA (-180C + 1600÷°C); DMA (-150C + 600÷°C); TMA (-150C + 1000÷°C); Rheometer (-100C + 400÷°C); Climatic chamber
- Static and Dynamic Mechanical line : Max load 250kN, Max speed 20 m/s, Impact Energy 1300J, Temp. range -70 +1400°C÷
- Material testing: The material testing capability of the unit include both infrastructure for the preparation and the observation of metal, ceramic and composite material samples and the instrumentation for material testing from the thermomechanical point of view.

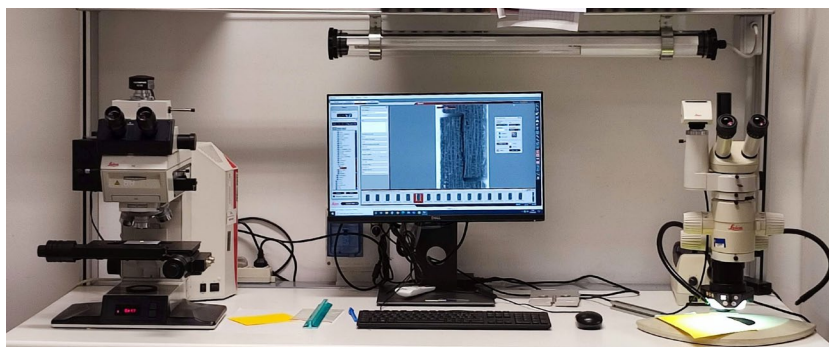


Figure 3: Optical microscopes



Calorimetric and rheological analysis: Modulated Scanning Differential Calorimetry, Thermomechanical Analysis, Dynamic Mechanical Analysis, Thermogravimetry, Rotational Rheometer



Destructive material testing: Static Electromechanical Material Testing up to 100kN, Dynamic Hydraulic Material Testing up to 250kN, High Deformation Rate Material Testing up to 20 m/s

- Metallic Additive Layer Manufacturing line: Electron Beam Melting (EBM) technology model ARCAM A2X

Application Domains

Aerostructures – Composite Materials and Processes, Metallic Materials and Processes; Manufacturing and assembly technologies; Analysis and Structural Design, hybrid structures; Nanostructured materials, Superhydrophobic/icophobic coatings as passive Ice Protection Systems.

Main measuring instruments/techniques

Each facility is equipped with specific measurement systems for process control (temperature, pressure, fiber tension, laser power, load, etc.). Moreover thermocouples, load cells and strain sensors are available. Additionally, instrumentation for the surface characterization (contact angle, surface free energy, work of adhesion, roughness, microscopy), along with tester for the paint adhesion and a probe to measure the paint thickness are available.

Operational Status

The Lab is operational.

Advanced Prototyping

An infrastructure dedicated to the creation of an Advanced Prototyping Center for Aerospace Structures is under construction and will be ended within June 2026.

It will be devoted to concurrent engineering design, prototype manufacturing and test polymer composite structures, as well as to enhance and scale up existing automated manufacturing capabilities for aerospace composite structures, including a Clean Room and Facility for Fiber/Tape Placement, Liquid Infusion and In and Out of Autoclave Processes.



5 kN cooled combustion chamber manufactured by AM process in Ti6Al4V