



# CMAT MATERIALS CENTER

## CMAT: RESEARCH TO INNOVATE AND TRANSFORM THE ECONOMY

The Materials Center (CMAT), *Centre des Matériaux*, established in Évry in 1967, is the largest of the 18 research centres at Mines Paris – PSL. The centre is a joint research unit (UMR 7633) affiliated with the CNRS, within its Engineering

Department. It is also a member of the Îlede-France Federation for the Mechanics of Materials, Structures and Processes, and the Île-de-France Federation for Metallurgy.



Theory and practice: confronting numerical simulation with mechanical testing in highly nonlinear behavior

CMAT specializes in structural materials for the aerospace, energy, space, automotive, and mechanical engineering sectors, as well as in advanced materials for electronics, energy storage, and biomedical applications.

The centre works closely with major industrial groups and SMEs to develop cutting-edge technological solutions. In line with a double-impact research approach, CMAT forges strong connections between academic research and industry—helping to shape the strategies of economic stakeholders and fostering innovative collaborations to meet today's major challenges.

### KEY FIGURES OF CMAT



#### defended at CMAT, out of the approximately 100 at Mines Paris - PSL

spread across two specialties of the ISMME 621 doctoral school:

- Systems Engineering, Materials, Mechanics, Energy
- Materials Engineering and Mechanics

STRATEGIC FOCUS AREAS OF CMAT: COLLABORATIVE RESEARCH BETWEEN PHYSICOCHEMISTS, MECHANICS EXPERTS, AND COMPUTATIONAL SCIENTISTS



Pressure field simulation on polycrystalline granulate applied to a tribology problem.

#### Three research hubs

#### Materials and Structures Simulation (SIMS)

The SIMS hub aims to improve the modeling of material behavior and fracture in computational codes. This includes the development of digital software and collaborations with other teams to compare theoretical models with experimental results, both at national and international levels.

#### Experimental Mechanics — Materials (MEM)

The MEM hub focuses on the study of metallic materials, polymers, composites, ceramics, and refractories. It seeks to understand deformation, damage, and fracture mechanisms through microstructural observations and analysis of physical parameters at various scales.

#### Genesis and Evolution of Microstructures (GEM)

The GEM hub studies phase transformation, deformation, and damage phenomena in materials, as well as the effects of the environment (oxidation, temperature, irradiation). It combines disciplines such as metallurgy, crystallography, and surface science to control and optimize material microstructures.

#### **Five support platforms**

At the service of research hubs and industrial and academic partners. Discover our areas of expertise.

#### AT-JPE: mechanical workshop

- Mechanical assemblies (mechanical testing machines, tribological image furnaces, etc.), machining of all types of test specimens
- Metal removal machining, spark erosion (electroerosion)
- Welding / Forming / Cutting

#### µMAX: microstructure, metallography, analysis, x-ray diffraction

- Optical Microscopy (OM)
- Scanning Electron Microscopy (SEM)
- Transmission Electron Microscopy (TEM)
- Metallography
- X-ray Diffraction (XRD)
- Physical Measurements

#### **EPROM:** elaboration, processes and materials

- L-PBF (Laser Powder Bed Fusion)
- MBJ (Metal Binder Jetting)
- Cold Spray
- 3D Printing
- Heat treatments
- Elaboration furnaces
- Powder Metrology

#### SESAMES: experimental support for materials and structures analysis

- Monotonic tests: Tension / Compression Creep / Relaxation
- Cyclic tests: Fatigue Fretting Thermal Fatigue
- Thermal: Resistive Furnaces / Radiant Furnaces / Induction / Climate Chambers
- Strain Gauging: Contact / Non-contact
- Kinematic Field Measurements: Thermal / Acoustic
- Environment and Atmosphere: Air / Gases / Vacuum / Aqueous
- Crack monitoring: Optical / Electrical Methods / Acoustic Emission
- Calibration (F, ΔL, T)

#### SISDEV: support in scientific computing and development

- Support for conducting studies (from project setup to execution) on scientific digital tools and electronic control and acquisition systems
- Consolidation, long-term maintenance, and enhancement of developments within dedicated digital tools
- Providing users with an ever-improving user experience
- Supporting and training in the use of digital tools (internal tools, external tools, programming in C++/Python/...)

### FUTURE PROJECTS

#### Mines Paris - PSL is in close synergy with the corporate world:

Around 1,000 new research contracts per year

200 industrial partners 81 patents, including 24 at CMAT

#### EPROM 2025: a center of excellence for additive manufacturing and materials health

The project, led by CMAT and supported by Carnot M.I.N.E.S, structures a cuttingedge technological platform for additive manufacturing. Its goal: to combine innovation, research, and training to address industrial challenges in the aerospace, space, and defense sectors.

In addition to its existing capabilities, the platform will feature a unique experimental setup for Wire Laser Additive Manufacturing (WLAM), enabling the production of large-scale parts while integrating an advanced materials health approach. This dual expertise will ensure precise control over material properties and optimize their durability.

Scheduled to be accessible to businesses by fall 2025, EPROM 2025 is a center of excellence supported by the Île-de-France region, dedicated to enhancing the skills of both industrial and academic stakeholders.

The Materials Center of Mines Paris – PSL follows a high-level research development policy in collaboration with industrial partners in the fields of aerospace, automotive, energy, nuclear, steelmaking, equipment manufacturing, and space.

#### The CMAT organizes its activities into three main areas:

Development of materials and processes

Experimental characterization and modeling of material behavior

Development of numerical models and structural calculations

## SUPPORT FOR INNOVATIVE PROJECTS

## Mines Paris – PSL mobilizes the expertise of its research teams and specialists to establish collaborations:

Exploring new markets

Access to funding and grants for collaborative projects

Strengthening teams through the integration of specialized skills (industrial PhD contracts, etc.)

Expanding professional networks and increasing visibility

Activities with high societal impact

## DID YOU KNOW?

## CMAT has trained over 500 PhDs since its creation in 1967.

![](_page_6_Picture_9.jpeg)

Jean-Jacques Favier Astronaut 1977: PhD Columbia STS-78 mission André Pineau 2000: National Academy of Technologies of France Samuel Forest 2022: Member of the French Academy of Sciences, "Mechanical and Computational Sciences" section

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