



KEY TECHNOLOGIES

Metallic, Ceramic and Composite Materials

Key words: *Micro-structural and nano-structural characterisation, thermomechanical behaviour, metallic alloys, structural ceramics, functional ceramics, porous materials, fibre composites*

THE TEAMS

The Equipe Structure et Comportement Thermomécanique des Matériaux (ESCTM, the structure and thermomechanical behaviour of materials team) has six full-time researchers or teacher scientists, four doctoral candidates and two post-doctoral candidates. The team works with the teams at the CRISMAT and LCMT in Caen. It also is involved in the 'Polymer Materials, Plastic Processing' networks and works on many national and European projects.

METHODS, SKILLS AND EXPERTISE

The team's work focuses on the following types of materials:

- ▶ Structural ceramics (such as clay- or plaster-based, carbide, oxide or nitride ceramics)
- ▶ Functional ceramics (dielectric, semi-conducting, and superconducting ceramics)
- ▶ Porous materials (ceramics, metals, and glass)
- ▶ Fibre composites (cement-glass, reinforced plaster, and reinforced polymer)

The equipment can develop porous materials, characterise the structure of materials, and study their thermomechanical behaviour under quasi-static or static stress, or dynamic structural loading.

- ▶ Development of (metallic or ceramic) sintered materials while controlling porosity – Example: bronze filters
- ▶ Qualitative structural analysis (type, phase localisation, study of the grain boundary using high-resolution electronic microscopy) – Examples: fibre-matrix interface analysis in cement-glass composites or study of interfaces in GaN-type semiconductors
- ▶ Quantitative structural analysis (content, spatial breakdown and organisation of the different phases using the tools of topology, stereology, and mathematical morphology) – Examples: description of the porous structure of ceramic substrates for nanofiltration
- ▶ Study of how mechanical damage starts and spreads in different loading modes (pure bending, buckling, uniaxial traction, and compression) and types of stress (static and monotone stress, and dynamic structural loading) – Examples: polyamide composites-glass fibre shocks
- ▶ Material reliability (durability, resistance to cracking, Weibull module) – Examples: nanofiltration substrates
- ▶ Heat transfer during hardening and resistance to thermal shock – Examples: heavy or porous materials in water, silicon oil, or liquid nitrogen
- ▶ Detection and monitoring of the damage using acoustic emission analysis

The thermomechanical behaviour of the material can be interpreted with the micro-structural data, hence enabling material optimisation.

SPECIAL EQUIPMENT

In addition to the microscopy equipment listed in the equipment chapter of the ImagMicro hub, the following equipment is also used:

- ▶ Two sintering furnaces (including one neutral atmosphere furnace)
- ▶ Equipment for metallographic preparation, optical microscope, scanning electron microscope with analysers, high-resolution electronic microscope with analysers, and image processing systems
- ▶ Three electromechanical traction-compression machines (100kN capacity), a compression system (2MN capacity), a hydraulic machine equipped with an air-conditioned chamber (temperatures ranging from minus 70°C to plus 230°C), a drop-weight shock-test machine (0.5 to 530 Joules), hardness test-bench, two acoustic emission analysis chains, a thermal shock test-bench

SUPPORT TO BUSINESS SET-UP PROJECTS IN BASSE-NORMANDIE

The Basse Normandie Region has rolled out all its resources to support business projects in the following areas:

- ▶ General funding
- ▶ Business project support
- ▶ Training programs
- ▶ Corporate user services at operations site
- ▶ Technology transfer to companies: www.gravir.org and www.ismra.fr and www.ispa.fr

COMMITTED COMPANIES

- ▶ BPB Placo (constructions materials)
 - ▶ CMEG (building and civil engineering)
 - ▶ BENOIT GIRARD (medical prosthetic devices)
 - ▶ MERITOR, RHODIA, SCHNEIDER ELECTRIC, THALES, VETROTEX
- Etc...

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For further information:

Browse our website to find out all about the many opportunities in Normandy, at www.normandydev.com or send an email to ndcaen@normandydev.com or ndrouen@normandydev.com

