CENTRE OF EXCELLENCE OF MULTIFUNCTIONAL ARCHITECTURED MATERIALS
46 avenue Félix Viallet 38031 Grenoble Cedex 01 FRANCE
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CEMAM
Laboratoire d'excellence

CORE COMPETENCE 2: ELABORATION

CEMAM gathers research teams from several laboratory partners. It promotes a "materials by design" approach, starting from "engineering challenges", and proposing a strategy to meet multi-functional requirements by associating multimaterials and architectures.

The development of research on architectured multifunctional materials requires to develop adapted elaboration processes at various dimensional scales. The consortium shares a large variety of techniques in AMEP (Architectured Materials Elaboration Platform).

THE AMEP ELABORATION PLATFORM

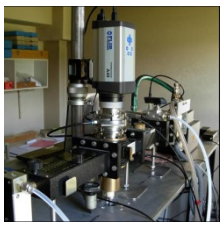
The AMEP platform can be divided in three main ways to elaborate architectured materials mainly depending on the type of materials to be produce:

- elaboration of multi materials
- elaboration of cellular materials
- elaboration of architectured surfaces

ELABORATION OF MULTIMATERIALS

Powder sintering including new sintering processes like microwave or induction sintering developed in the framework of the Labex. Such developments are also carried out in collaboration with other laboratories and platforms in Rhône-Alpes region.

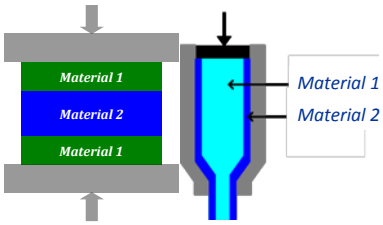
Dilatometry equipments are also available, including an optical dilatometer which is particularly well adapted to follow sintering of multimaterials.


a


b.

a. Microwave sintering equipment
b. Optical dilatometry

Multimaterials (in particular in the case of metallic materials) can also be produced by thermo mechanical processing. Rolling and extrusion equipments are available including non conventional conditions (e.g. Equal Channel Angular Extrusion or asymmetric rolling). Co pressing, co extrusion or co rolling at various temperatures can be performed.



LABORATION OF CELLULAR MATERIALS

Cellular materials can be produced thanks to various dedicated equipments.

Salt preform infiltration is one of the techniques available on the platform. After infiltration, the composite is immerged in water to dissolve salt, producing the desired foam. This technique is for instance particularly well adapted for elaboration of aluminium foams.




Combining long term competence with short notice reactivity

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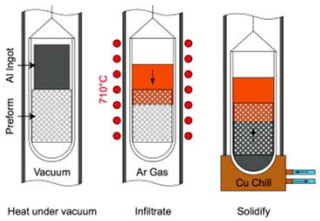
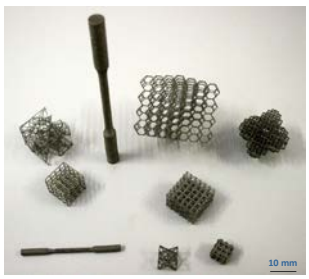


Example of infiltration strategy

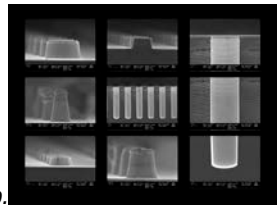
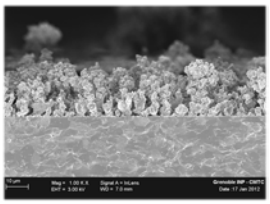
Additive manufacturing of metallic alloys is another technique available on the platform. With Additive Manufacturing, parts are built layer per layer by selective melting of powders. Material is added instead of removed, as is the case in traditional machining. Each layer is melted to the geometry defined by a CAD model. In consequence, additive Manufacturing allows for building parts with very complex geometries and is particularly well adapted for producing architectured metallic components. The equipment is an Electron Beam Melting (EBM) device working under vacuum which ensures a good metallurgical quality and fully dense melted zones.
The electron beam is managed by electromagnetic coils providing fast and accurate beam control that allows several melt pools to be maintained simultaneously.

a. 
b. 

a. EBM equipment
b. Examples of components in Ti alloy elaborated by additive manufacturing

ELABORATION OF ARCHITECTURED SURFACES

Chemical-based coating techniques like CVD (Chemical Vapor Deposition including HTHCVD, MOCVD, Aerosol assisted MOCVD), ALD (Atomic Layer deposition including Plasma Enhanced ALD), wet chemistry or ESD (Electrostatic Spray Deposition), a unique technique in France, are available on the platform. They allow the elaboration of architectured coatings (multi-layers or coatings with specific architecture such as coral type or reticulated morphology or nanowires for instance) on various substrates. Various types of materials are available (oxides, carbides, nitrides, metals). Coatings with well controlled stoichiometry, conformity and thicknesses (from nanometers to micrometers) or with graded composition can be obtained.

a. 
b. 
c. 

a. ALD coatings with well controlled conformity b. ESD coating with coral type morphology c. High Temperature Halide CVD

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