MASTER MATERIALS SCIENCE AND ENGINEERING

IN BRIEF

Type of diploma: Master degree
Ministry field(s): Science and Technology

TRAINING CONTENT

The Materials Science and Engineering Master is a general training aiming at giving proper scientific knowledge to students wishing to work in the Materials industry or research. Each course addresses the specific requirements of the socio-economic backgrounds with the support of research activities.

The Materials Science and Engineering Master offers three courses:

- M2 Chemistry and Physico-Chemistry of Materials
- Master degree "Bio-Inspired Materials"
- M2 Materials Engineering: Development, Characterization, Applications (MEDCA)

ORGANIZATION

- M2 Chemistry and Physico-Chemistry of Materials
- Master degree "Bio-Inspired Materials"
- M2 Materials Engineering: Development, Characterization, Applications (MEDCA)

ORGANIZATIONAL UNIT

Collège Sciences et Technologies pour l’Energie et l’Environnement (STEE)

PLACES

Pau, Tarbes

PERSON IN CHARGE
The selection and appropriate use of a material requires chemical expertise that draws on knowledge of the material preparation and characterization sectors, and training in interpretation and modeling of the structural and functional properties of materials.

Designed specifically for students taking courses in which chemistry is the predominant subject, the CPCM (Chemistry and Physical Chemistry of Materials) curriculum offers training courses in each of these different sectors.

The content of the teaching program is the result of a general synthesis concerning sustainable development and the use of innovative materials that provide a potential response to new requirements and challenges related to energy and the environment.

The teaching program, comprising lectures, supervised and practical work and case studies, is taught by university lecturers and researchers, but also by personnel from the socio-professional sector.

The practical works and case studies are done in the laboratories of the Multidisciplinary Research Institute for the Environment and Materials (IPREM CNRS UMR 5254), using high-performance and top-level apparatus.

The program also includes modules that prepare students for entering the labour market:
* Use of English in courses and for writing scientific papers
* Internships in companies and academic research laboratories

OBJECTIVES

* Prepare students at an advanced specialized level to meet present and future challenges in areas of expertise in chemistry, polymers, inorganic chemistry and modeling
* Develop engineering research skills to engage in quality and successful research,
* Prepare students for leading positions in industry and government Research and Development departments.

SKILLS

At the end of this program, the students in the «Materials Science and Engineering: Chemistry and Physico-Chemistry of Materials master’s degree” will be able to:

* Prepare materials and samples,
* Use surface and volume analytical techniques to acquire a good command of materials characterization,
* Validate, interpret and model experimental results,
* Write a synthesis report and communicate appropriately with experts,
* Produce quality research,
* Carry out a research project.

ADDITIONAL INFORMATION

* Region Aquitaine Scholarships for non-EU students
* E2S Talents’ Academy Scholarships for all students
* EIFFEL Scholarship of Excellence
* Specific Master's scholarship

TRAINING CONTENT

Projects and practical works are carried out in the laboratories of the Multidisciplinary Research Institute for the Environment and Materials (IPREM) on high performance equipment.
The program also includes preparation modules for professional integration, the practice of scientific English as well as internships in companies or in academic research laboratories.

Additionally, the CPCM course offers course units delivered in collaboration with the Universities of Toulouse, Montpellier and Bordeaux as part of the French Theoretical Chemistry Network (RCTF).

<table>
<thead>
<tr>
<th>Semester 3</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title</strong></td>
<td></td>
</tr>
<tr>
<td>Materials for energy storage and conversion</td>
<td>4</td>
</tr>
<tr>
<td>Materials: nano materials, bio materials and hybrid materials</td>
<td>4</td>
</tr>
<tr>
<td>Surface chemistry and interfaces</td>
<td>4</td>
</tr>
<tr>
<td>Modelisation of materials with specific properties</td>
<td>4</td>
</tr>
<tr>
<td>Optical properties of materials</td>
<td>4</td>
</tr>
<tr>
<td>Methods and techniques for polymer-based materials synthesis</td>
<td>4</td>
</tr>
<tr>
<td>Natural polymers – biomass valorization (optional)</td>
<td>4</td>
</tr>
<tr>
<td>Project management – industrial property and patents (optional)</td>
<td>2</td>
</tr>
<tr>
<td>Formulation of adhesives (optional)</td>
<td>2</td>
</tr>
</tbody>
</table>
Theoretical chemistry applied to the study of materials (optional) | 4

| Semester 4 | 
| --- | --- |
| **Course Title** | **ECTS** |
| Internship in research in the fields of polymer chemistry, inorganic chemistry, materials, energy, storage and conversion, physical-chemistry, theoretical chemistry | 30 |

**Organization**

Semestre 3

- **UE Obligatoires (Mandatory)**
  - Materials For Energy Storage And Conversion
  - New materials
  - Physico chemistry of surfaces and interfaces
  - Modeling of materials with specific properties
  - Optical properties of materials
  - English for communication

- **UE Optionnelles (Optional)**
  - Polymer-based materials processes and techniques
  - Natural polymers and biomass valorisation
  - Adhesion and adhesives
  - Theoretical Chemistry and spectroscopies
  - Theoretical chemistry applied to the study of materials
  - Nanomaterial-based composites
  - Composites et nanomatériaux : Nanomatériaux
  - Réalités industrielles

Semestre 4

- **UE Obligatoires (Mandatory)**
English Language Requirements

Applicants must be fluent in English, both in writing and speaking. An applicant whose native language is not English has to take a recognized international English test.

**Minimum required score:**  CECRL B2 level in English

**EXPENSES**

Concerning the registration fees, the ministerial decree of 19 April 2019 sets the annual amount for non-European students enrolling in a Master's degree at €3770.

However, each French higher education institution has the possibility to partially exempt its students from these tuition fees.

For the year 2020-2021, the UPPA will apply this partial exemption to all non-EU students. Students benefiting from this partial exemption will pay an annual registration fee of 243 euros (2019_2020 price list as an indication)

**PROFESSIONAL INSERTION**

* Chemistry
* Energy (photovoltaic, batteries, fuel cells, artificial photosynthesis ..)
* Environment (non-polluting materials, pollution control materials and storage...)
* Aeronautics (composite materials, surface treatments ...)
* Building (thermal and sound insulating coatings ...)
* Cosmetics & life science
* Research and Development
* Research and Innovation Engineer, PhD students
* Project Manager
* Senior manager in design and development (design engineer)
* Senior manager in production (process engineer, production engineer)
* Senior manager responsible for quality operations or even production management
* Technical Director (R & D)
* Teacher-researcher (possible at the end of a doctorate.)

ORGANIZATIONAL UNIT

Collège Sciences et Technologies pour l'Energie et l'Environnement (STEE)

PLACES

Pau

PERSON IN CHARGE

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MASTER BIM

Bio-Inspired Materials

An educational background to enable a connection between the laboratory and the living world.

Research and development of innovative materials drawn from Nature

Facing technology, economical and environmental challenges

Is it possible to draw from Nature to process glass at ambient temperature and pressure? To get inspired by a tree leaf to capture and store sunlight energy? To draw from Nature to replace micro- and nano-plastics? To generate color without dyes? To dive into the ocean to discover novel UV filters or flame retardants?

To adopt a biomimetic approach is crucial for the future of several fields of activity, from agriculture to chemistry, through the housing, cosmetics, wood-paper and automotive industries. All of these currently face the challenges of sustainable development, energy saving and circular economy.

The stakes are high; we need to change our societies so that they are compatible with their environment.
In both the first and the second year of the master, the students will be trained to draw inspiration from nature through a biomimetic approach. This multidisciplinary approach, which resorts to both fundamental science and materials engineering is based on the observation and comprehension of living organisms within their ecosystems. A strong effort of abstraction to establish biological models to be adapted to scientific concepts and technological developments will be key to the course.

**OBJECTIVES**

* To train future scientists in materials science and engineering
* To explore innovative approaches
* To develop materials inspired by living systems with special regards to their composition, function, structure, architectures and processing, in line with environmental sustainability.

**SKILLS**

**Adopt the biomimetism philosophy**

For one or two years, BIM MSc students will have the opportunity to:

* Acquire basic and requisite knowledge in physics, chemistry and biology,
* Develop their curiosity and respect for living systems,
* Develop their environmental awareness,
* Develop open and collaborative working skills,
* Integrate principles of the living world in their scientific approach,
* Adopt a biomimetic approach from the concept to the materials development.

**ADDITIONAL INFORMATION**

* Region Aquitaine Scholarships for non-EU students
* E2S Talents’ Academy Scholarships for all students
* EIFFEL Scholarship of Excellence
* Specific Master’s scholarship
Corinne NARDIN

Corinne is physics professor, with a specialization in the physical chemistry of polymers, at the Université de Pau et des Pays de l’Adour. She is a scientific officer of the excellence initiative– Science - Innovation - Territoires – Economie (I-Site) « Energy and Environment Solutions – E2S ».

The training during the BIM Master will be focused on active pedagogy, in the project mode, which will be possible owing to a unique location of the teaching and research activities. Lectures will be at first organized to harmonize the basic knowledge of students of various educations (biology, physics and chemistry). 50 % of the lectures delivered to the 15 students are specific to the BIM master.

Through this approach, we further expect to develop the student’s soft skills in particular:

encourage autonomy, stimulate curiosity, creativity and emotional intelligence. The principal objective is to train future young researchers granted with a peculiar ability to think in a collaborative mode and to drive bio-inspired research projects.”

Laurent BILLON

Professor in Polymer Science at the Université de Pau et des Pays de l’Adour, Laurent is vice director of the Institute of Analytical Sciences and Physical chemistry for Environment and Materials (IPREM). He is the coordinator of the European research project eSCALEd on artificial photosynthesis and leads the group on bioinspired materials ‘Functionality &Self-Assembly’.

The BIM Master, that stands for Bioinspired Materials, is in line with the current challenge of the ecological and sustainable transition. Mimic strategies evolved by Nature represents infinite scientific and technological challenges that will be undertaken by choosing bioinspiration and biomimetism.
With this master, unique in France, we aim at proposing to the students to explore living systems to get inspiration to develop novel materials and to keep in mind ethics and consciousness of their environment. Multi- and trans-disciplinarily training, at the heart of the biomimetic approach, will enable the students to adopt new ways of thinking syntheses, formulations and processing of tomorrow materials needed by the industrial partners to build our future society.”.

**Internship**
Mandatory (4-6 months)

**Master 1**
A Minimum of 2 to 4 months of immersion in an academic or private research lab, in France or abroad

**Master 2**
Applied research project of at least a 6-month duration in an academic or private research lab

**ACCESS CONDITIONS**

- Applicants must hold at least a bachelor degree in chemistry, biology, physics, earth science for the Master 1 level.

- Applicants must hold at least a 4-year university level in chemistry, biology, physics, earth science for the Master 2 level
Applicants must be fluent in English, both in writing and speaking. An applicant whose native language is not English has to take a recognized international English test.

**Minimum required score:** CECRL level in English

None

### INSCRIPTION MODALITIES

Applications are now open here  

### TARGET

International and French students

### EXPENSES

Concerning the registration fees, the ministerial decree of 19 April 2019 sets the annual amount for non-European students enrolling in a Master’s degree at €3770.

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For the year 2020-2021, the UPPA will apply this partial exemption to all non-EU students. Students benefiting from this partial exemption will pay an annual registration fee of 243 euros (2019-2020 price list as an indication)

### ORGANIZATIONAL UNIT

Etablissement  
Collège Sciences et Technologies pour l’Energie et l’Environnement (STEE)

### PLACES

Anglet

### PERSON IN CHARGE

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Phone 05.59.40.76.09

Nardin Corinne
corinne.nardin@univ-pau.fr
M2 Materials Engineering: Development, Characterization, Applications (MEDCA)

**PRESENTATION**

Applications are now open here

Applications will be closed on April 24th, 2020

MEDCA (Materials Engineering Development, Characterization, Application) graduates will attend theoretical and practical physics-oriented courses on materials that will include Life cycle assessment (recycling) and the environmental impact (eco-designing). They will then acquire skills in the fields of polymers, composites, nanomaterials, metallic materials and ceramics.

**OBJECTIVES**

The MEDCA course objectives are:

* To give students Mastery of the characterization concepts and techniques of Materials Engineering with a view to training general managers in this industrial sector.
* To help students acquire skills in the fields of polymers, composites, nanomaterials, metallic materials and ceramics.

**SKILLS**

At the end of this program, the students in the "M2 Materials Engineering: Development, Characterization, Applications (MEDCA)" will be able to:

* Participate in the development and implementation of various materials (polymers, composite materials,
elastomers, nanocomposites, nanomaterials) for the development of products or prototypes via 3D printing.
* Analyse material transformation techniques or processes in order to optimize the production tool.
* Carry out qualification and quality control tests to participate in the overall effort to improve the quality of production.
* Write reports, projects, technical reports.
* Carry out expertise missions on existing products in order to identify by example the origin of the degradation of parts under industrial operating conditions.

**ADDITIONAL INFORMATION**

* Region Aquitaine Scholarships for non-EU students
* E2S Talents’ Academy Scholarships for all students
* EIFFEL Scholarship of Excellence
* Specific Master’s scholarship

**TRAINING CONTENT**

**M2 Materials Engineering: Development, Characterization, Applications (MEDCA)**

**Semester 1 (30 ECTS) - From September to December**

<table>
<thead>
<tr>
<th>MANDATORY COURSES (26 ECTS)</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Adhesion and adhesives (34hrs)</td>
<td>4</td>
</tr>
<tr>
<td>* Thermoplastic elastomers &amp; rubbers (26.5hrs)</td>
<td>3</td>
</tr>
<tr>
<td>* Polymers and the environment (36hrs)</td>
<td>4</td>
</tr>
<tr>
<td>* Designing parts 2 (56hrs)</td>
<td>6</td>
</tr>
<tr>
<td>Course Description</td>
<td>ECTS</td>
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<tr>
<td>--------------------------------------------------------</td>
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</tr>
<tr>
<td>* Nanocomposites and nanomaterials (36hrs)</td>
<td>4</td>
</tr>
<tr>
<td>* Processing of polymer materials (27hrs)</td>
<td>3</td>
</tr>
<tr>
<td>Elective courses (4 ECTS) Choose 2/3 courses</td>
<td>ECTS</td>
</tr>
<tr>
<td>* Composites based on bio-resources (16.5hrs)</td>
<td>2</td>
</tr>
<tr>
<td>* Business world (21hrs)</td>
<td></td>
</tr>
<tr>
<td>* Polymers for the living organisms (16.5hrs)</td>
<td></td>
</tr>
<tr>
<td>Semester 2 (30 ECTS) From January to June</td>
<td>ECTS</td>
</tr>
<tr>
<td>Compulsory internship</td>
<td>30</td>
</tr>
<tr>
<td>* Internship in a company or a laboratory</td>
<td></td>
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</tbody>
</table>

**ACCESS CONDITIONS**

This course is intended for students originating from fields where physics, engineering, physics, mechanical, construction, materials in the broad sense are predominant.

Applicants must be fluent in English, both in writing and speaking. An applicant whose native language is not English has to take a recognized international English test.

**Minimum required score:** CECRL level in English
International and national students

EXPENSES

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PROFESSIONAL INSERTION

At the end of this course, the graduate in a Master SGM-IMECA will be able to quickly integrate the following fields and sectors:

Sectors

* Production
* R&D
* Expertise
* Quality
* Design office

Fields

* Aeronautics
* Automotive industry
* Agri-food
* Packaging
* Railway industry
* Water sports
* Standardization and quality management
REORIENTATION

Doctoral thesis in an academic or industrial research laboratory.

ORGANIZATIONAL UNIT

Etablissement

PLACES

Pau

ADMINISTRATIVE CONTACT(S)

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