Universidad Zaragoza

Academic Year/course: 2023/24

66111 - Assembly and Fabrication of Nanoestructures

Syllabus Information

Academic year: 2023/24
Subject: 66111 - Assembly and Fabrication of Nanoestructures
Faculty / School: 100 - Facultad de Ciencias
Degree: 539 - Master's in Nanostructured Materials for Nanotechnology Applications
ECTS: 6.0
Year: 1
Semester: First semester
Subject type: Compulsory
Module:

1. General information

The aim of this course is to make students aware of the importance of order at the atomic and molecular levels and how this order can determine the properties of a nanostructured material. It is precisely this order that, naturally or imposed by different assembly techniques, directed intermolecular interactions, 'click' chemical strategies, controlled polymerization, chemical functionalization of nano-objects, etc., can create properties that condition the possible applications and uses for these materials. The necessary basic chemistry concepts are introduced to make the molecular self-assembly and self-organisation processes understandable as they let students make practical use of this chemistry to the benefit of the production of nanostructures.

These approaches and objectives are aligned with the achievement of SDG 9. Industry, innovation and infrastructures of theAgenda 2030. More specifically, they will create action to enhance research, foster innovation and upgrade industrial technologies.

2. Learning results

- Clearly identify the different nanostructure types (0D, 1D, 2D and 3D) and the chemical and physical methods available for their production.
- Recognise the different supramolecular and macromolecular architectures, their importance in chemistry and their potential application in various fields in Nanotechnology, suggesting rational structural designs and effective chemical synthesis tools to produce and assemble functional structures.
- Make use of the necessary chemical and chemical-physical knowledge to realize about the real applications of the assembly and production of functional nanostructures.
- Plan, design and undertake experiments aimed at producing nanomaterials by bottom-up, evaluating the problems, risks and results.

3. Syllabus

The course will address the following topics:

- Nanomaterials, nanostructures and their production: nanoparticles, quantum points, nanotubes, nanothreads, nanosheets, nanocomposites, block copolymers, dendrimers and liposomes.
- Hierarchical self-assembly and molecular self-organisation: liquid crystals, helical nanostructures, growth by biochemical self-assembly, etc.
- Surface chirality.
- Nanostructures functionalization. Inorganic layers.

The theory classes are complemented by six practical sessions including: Synthesis of Nanoparticles by wet chemistry, Synthesis of Nanoparticles by Laser pyrolisis, Synthesis of nanowires by wet chemistry, Preparation of block co-polymer micelle aggregates, Helical nanostructures based on liquid crystals, Preparation of inorganic films and coatings from individual entities.

4. Academic activities

- **Lectures (4 ECTS)**. Lecture notes and a set of problems (and their corresponding solutions) will be available for the students. The lecturers will provide the students with notes, handouts or summaries of class content prior to the

beginning of the class (preferably via Moodle) along with the recommended reading for more in-depth understanding of the topic. Additionally, open forum activities on the basic concepts and their application, comparison with real developments, problem-solving and practical case studies are included in this module.

- **Laboratory Sessions (2 ECTS)**. Laboratory practicals through which the student will face real problems during the preparation of nanostructured materials. Thanks to the work with their colleagues in practical groups, the students will develop group work skills.
- **Assignments**. At the end of every topic, each student will complete the Q&As that the lecturers give them over the course.
- **Autonomous work**. Students are expected to spend about 95 hours to study theory, solve problems, prepare lab sessions and assignments and take exams.

5. Assessment system

For students choosing **Continuous Assessment** (attendance to at least 80% of this module lectures is required)

1.- Written exam (33% of the final result for the module) where the abilities acquired by the student in the shape of theoretical knowledge obtained in relation to nanostructure assembly and production are assessed. The exam will feature theory matters including: (i) topic(s) expanded from those corresponding to the contents of this subject and (ii) short answer or multiple choice questions

2.- Individual Assessments including problem solving, exercises and questions during the classes answered by the student at that time or later according to the lecturer's indications (33% of the final result of the module).

3.- Practical Assessment (33% of the final result for the module) where the abilities and skills of the students in the laboratory, instrument handling ability, accuracy performing experiments, attention to detail, ability to solve problems or unforeseen difficulties that may arise, ability to work on experiments in a group, and answers to multiple choice questions and Q&As laid out before, during and/or after the practical sessions

A minimum qualification of 4 out of 10 is needed in each of the three parts to pass the subject. In any case, the average over the three sections must be at least 5 out of 10 to pass the subject.

For students that did not pass the ongoing assessment or wish to increase their mark **Global Assessment** comprising a written test (75%), a practical exam (25%).