UAB
Universitat Autònoma de Barcelona

Nanomaterials Synthesis

Code: 106832
ECTS Credits: 6

2025/2026

Degree	Type	Year
Nanoscience and Nanotechnology	OB	3

Contact

Name: Jordi Hernando Campos

Email: jordi.hernando@uab.cat

Teachers

Fernando Novio Vazquez

Teaching groups languages

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Prerequisites

Students should have taken and passed the 2nd year subjects "Chemistry of the Elements" and "Organic Chemistry", and have taken the 1st semester subject of the 3rd year "Supramolecular Chemistry and Molecular Recognition". Many concepts from these subjects will be used without prior explanation.

Objectives and Contextualisation

The aim of this course is for students to acquire knowledge about the most common methods used for the synthesis of nanomaterials, which will allow them to interpret and propose processes for the preparation and functionalisation of these types of materials. In addition, the course will also provide knowledge about the structure and properties of nanomaterials.

Learning Outcomes

1. CM25 (Competence) Propose optimal synthesis, fabrication and characterisation methods based on the desired properties and functionalities of nano-systems.
2. CM26 (Competence) Design nano-systems that meet the requirements of specific innovative applications.
3. CM27 (Competence) Work in teams to develop practical cases in the field of nanotechnology and assess their social, economic and environmental impact.
4. KM44 (Knowledge) Distinguish between the different types of nanomaterials and nano-systems, as well as the main techniques used to synthesise and characterise them.

5. SM37 (Skill) Synthesise and characterise nanomaterials, as well as simple micro and nano-systems.
6. SM40 (Skill) Use digital tools and documentary sources to obtain, analyse and present information from a critical perspective in the field of nanotechnology.

Content

1. Introduction to nanomaterials

The nano dimension: general aspects and physico-chemical principles. Types of nanomaterials. Top-down and bottom-up methodologies.

2. Preparation of self-assembled monolayers, thin layers and nanostructured surfaces

Self-assembled monolayers (SAMs): metal-thiol, glass-silane, silicon-alkene. Functionalization of SAMs. Nanostructuring of surfaces by means of lithographic techniques. Self-assembled multilayers: layer-by-layer deposition techniques. Other thin-layer deposition techniques.

3. Synthesis of nanoparticles and 1D nanostructures

General aspects: nucleation and growth. Stability. Metallic nanoparticles: reduction method and organometallic approach method. Semiconductor nanoparticles: hot injection method. Metal oxide nanoparticles: precipitation method and sol-gel method. Polymeric nanoparticles: precipitation method and emulsion methods. Processing and functionalization of nanoparticles. Anisotropic growth of nanomaterials: spontaneous and templated-based bottom-up methods. Examples and applications.

4. Preparation of inorganic, organic and hybrid nanoporous materials.

Introduction: micro- and mesoporous materials. Zeolites: hydrothermal method. Mesoporous silicates: sol-gel method. Coordination polymers, metal-organic networks and organic covalent networks.

5. Preparation of carbon nanostructures and 2D systems

New forms of carbon. Fullerenes: synthesis, structure, properties and applications. Quantum carbon dots. Carbon nanotubes: nomenclature, synthesis, properties and applications. Graphene: synthesis, properties and applications. Other 2D materials analogous to graphene.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lab practices	12	0.48	CM27, SM37, SM40, CM27
Theory lectures	40	1.6	CM25, CM26, KM44, CM25
Type: Supervised			
Tutoring	4	0.16	CM25, CM26, KM44, CM25
Type: Autonomous			
Autonomous study	76	3.04	CM25, CM26, CM27, KM44, CM25

Students will have to develop various types of activities throughout the subject:

a) Directed activities: In the classroom, theory lectures will be held on the contents of the subject. On the other hand, the students will also carry out practices in the chemistry laboratory consisting of the synthesis of nanomaterials.

b) Autonomous activities: Independently, students must study the contents of the subject, solve problems, prepare laboratory practices and write reports for these practices.

c) Supervised activities: The student may request support tutorials from the teaching staff of the course for the assimilation of the subject presented in the theory classes, and for the resolution of follow-up work.

Note: 15 minutes of a class will be reserved within the calendar established by the centre or by the degree for students to fill in the surveys for the evaluation of the teaching staff's performance and the evaluation of the subject or module.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Lab reports	15%	10	0.4	CM27, SM37, SM40
Short exercises	10%	2	0.08	CM25, CM26, CM27, KM44
Written exams	75%	6	0.24	CM25, CM26, KM44

The evaluation can be carried out in two modalities:

A) Continuous evaluation

Written theory exams: Two midterm exams will be held throughout the course, one in the middle and the other at the end of the semester. Each of these exams will have a weight of 37.5% on the final grade.

- First midterm: The contents of Lessons 1 to 3 will be evaluated (37.5% of the final grade)

- Second midterm: The contents of Lessons 4 to 5 will be evaluated (37.5% of the final grade)

Exercises: Throughout the course, 4-6 exercises will be carried out in person in the classroom, whose average grade will contribute 10% to the final grade.

Laboratory practices: Laboratory practices will be evaluated by correcting reports, whose grade will be equivalent to 15% of the final grade of the subject.

The final grade will be obtained as: Final grade = Written exam grade (75%) + Evidence grade (10%) + Practice grade (15%).

In order to pass the subject, the grades obtained for each of these sections must meet the following conditions:

1) The grade of each of the written theory exams must be equal or higher than 4.0.

2) The average grade of the two written theory exams must be equal or higher than 5.0.

3) The weighted average grade for all the assessment activities of the subject must be equal or higher than 5.0.

4) Have attended the 3 sessions of laboratory practice.

Students who do not meet conditions 1 and/or 2 must take a retake exam at the end of the semester, which will be independent for each of the two parts of the course. The grade obtained in this retake exam will replace that of the corresponding previous written exams. In order to take the final exam, students must have participated in assessment activities throughout the course that are equivalent to 2/3of the grade of the subject. Otherwise, the grade will be "Not assessed".

If after the retake exam, the student does not meet conditions 1 and/or 2, the maximum grade they can obtain will be 4.8.

B) One-step evaluation: Within a single activity at the end of the semester, the following activities will be carried out:

Written theory exam: A single theory exam will be carried out that will have a weight of 85% on the final grade. That final exam will be divided into two parts, each of which will be evaluated separately with a weight of 42.5%.

Laboratory practices: The report of the laboratory practices will be delivered, whose grade will be equivalent to 15% of the final grade of the subject.

The final grade will be obtained as: Final grade = Written exam grade (85%) + Internship grade (15%).

In order to pass the subject, the grades obtained for each of these sections must meet the following conditions:

1) The grade of each of the two independent parts of the written theory exam must be equal or higher than 4.0.

2) The grade of the written theory exam must be equal or higher than 5.0.

3) The weighted average grade for all the assessment activities of the subject must be equal or higher than 5.0.

4) Have attended the 3 sessions of laboratory practice.

Students who do not meet conditions 1 and/or 2 must take a retake exam later, which will be independent for each of the two parts of the course. The grade obtained in that retake exam will replace that of the parts of the previous written exam that were to be retaken. In order to take the retake exam, students must have previously participated in the activities of the single assessment. Otherwise, the grade will be "Not assessed".

If after the retake exam, the student does not meet conditions 1 and/or 2, the maximum grade they can obtain will be 4.8.

Laboratory safety warning: Students who are involved in an incident that may have serious safety consequences may be expelled from the laboratory and fail the subject, regardless of the assessment modality selected.

Bibliography

Bibliografía

G. Cao, Nanostructures and nanomaterials: synthesis, properties and applications, Imperial College Press, London, 2004. Link.

G. Cao and Y. Wang, Nanostructures and nanomaterials: synthesis, properties, and Applications, 2011, World Scientific.

G. A. Ozin, , A. C. Arsenault, , L. Cademartiri, Nanochemistry: a chemical approach to nanomaterials, 2009, Royal Society of Chemistry. Link.

Institute of Physics & J. M. de Teresa, Nanofabrication: nanolithography techniques and their Applications, 2020, IOP Publishing. https://doi.org/10.1088/978-0-7503-2608-7.

Software

In this subject, the use of Artificial Intelligence (AI) technologies is allowed as an integral part of the development of the work, provided that the final result reflects a significant contribution of the student in the analysis and personal reflection. The student will have to clearly identify which parts have been generated with this technology, specify the tools used and include a critical reflection on how they have influenced the process and the final result of the activity. Lack of transparency in the use of AI will be considered a lack of academic honesty and may lead to a penalty in the grade of the activity, or greater penalties in cases of seriousness.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(TE) Theory	1	Catalan/Spanish	second semester	afternoon