66108 - 8.b. Synthesis and Processing of Nanostructured Materials

Course 2013 - 2014

Curso: 1, Semestre: 0, Créditos: 5.0

Basic information

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Recommendations to attend this course

The "*Synthesis and Processing of Nanostructured Materials*" module is obligatory and counts for 5 ECTS credits or 125 student work hours. The course is given in the second term of the academic year. As with the other modules in this Master's, this module is taught and assessed completely in English.

The objective of this module is for the student to specialise in the chemical processes involved in the synthesis and processing of nanostructured materials. Therefore, it is recommendable that the students taking this option come from a chemistry or similar qualification (chemical engineering, science of materials, etc.) course or degree.

As the whole course is taught in English, students need to have an upper-intermediate level in the language: minimum level B1 in the European Common Framework Language Reference, but preferably level B2. Level B1 is reached when the student is able to understand the main points of clear, standard-language texts when covering known matters - whether in terms of work, study or leisure; when able to cope in most situations which the student encounters during a trip to places where the language is spoken; when able to write simple, coherent texts on familiar topics or those in which the student has an interest; and when able to describe experiences, happenings, wishes and ambitions as well as briefly justify opinions or explain plans. B2 is achieved when the student is able to understand the main ideas of complex texts that deal with both specific and abstract topics, even if these are technical - though within the field of specialisation; when able to communicate with native speakers with the degree of fluency and ease such that the communication takes place without effort on either side; and when able to write clear, detailed texts on diverse subjects as well as defend a point of view on general topics - giving the

pros and cons of the different options.

Course Schedule and Deadlines

The module is taught in the second term, in May, and lasts about three and a half weeks.

The course is given in the afternoon and the calendar for classes and exam dates will be published prior to the beginning of each academic year in the web site of the Faculty of Science (https://ciencias.unizar.es/web/horarios.do).

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Learning outcomes that define this course

The student, in order to pass the course, will have to show her/his competence in the following skills:

1:
Recognise and identify the types of forces operating at nanoscale, the influence of surface effects and the consequences to the properties of the materials.

2:
Be able to design and execute synthesis processes and nanostructured material processing.

3:
Understand how tiny changes in the chemical structure or molecular or supramolecular architecture obtained can lead to the unique, singular properties of these materials.

Introduction

Brief presentation of the course

In this module, the student studies in depth distinct aspects of organic and physical chemistry in their application to the nanoscopic world, emphasising the practical aspects that lead the student to the synthesis and production of nanostructured materials.

The contents of this subject are:

Surface physical chemistry (surface energy, chemical potential as a function of surface curve, Young-Laplace equation, Kelvin equation; Consequences and applications; Capillarity; Cohesion and Adhesion; Electrostatic stabilization [DLVO theory], steric stabilization, etc.). O-D nanostructures (nanoparticles: homogeneous nucleation, synthesis in micelles or microemulsions, aerosol synthesis, "spray-pyrolysis", etc.). 1-D nanostructures (nanothreads, nanotubes: spontaneous growth, VLS or SLS growth, stress-induced recrystalization, "electrospinning", lithography, etc.). 2-D nanostructures (ultra-thin films: physical vapour deposition (PVD): evaporation, molecular beam epitaxy (MBE), "sputtering", chemical vapour deposition (CVD), atomic layer deposition (ALD), self-assembly, LB films, electro-chemical deposition, sol-gel films, etc.). Nanoscience and Nanotechnology special interest materials and their applications (fullerenes, carbon nanotubes, dendrimers, block co-polymers, micro- and mesoporous materials, "core-shell" structures, organic-inorganic hybrids, intrusion compounds, nanocomposites, clusters, molecular machines, etc.).

Competences

General aims of the course

The expected results of the course respond to the following general aims

The subject and its expected results respond to the following general planning and objectives:

This is an optional module designed to give students who have significant prior training in Chemistry a more advanced and specialised level in the application of this discipline to Nanoscience and Nanotechnology.

Context/Importance of the course for the master degree

Context and position of the subject in the qualification:

This module is taught in the second half of the course when the students already have broad general knowledge of Nanoscience and Nanotechnology. With this broad view of the issue, it is intended to return to the starting point and the basic training of the students (Chemistry, Science of Materials, Chemical Engineering, etc.) to give them highly specialised tools in Chemistry to resolve problems at the nanoscale.

After completing the course, the student will be competent in the following skills:

1:
Identify opportunities to apply the theory and knowledge of the chemical processes for the production, processing and functionalization of materials as well as their use for the creation of specific devices and applications.

2:
Analyse and design materials synthesis, processing and functionalization processes and evaluate how changes - often subtle ones - in chemical or supramolecular structure in the materials create unique and singular properties that may be employed in the construction of nanodevices and nanosystems.

Relevance of the skills acquired in the course

Through this highly specialised module, the student can apply this knowledge to the solving of problems of interest to the nano world.

Evaluation

Assessment tasks

The student will prove that he/she has achieved the expected learning results by means of the following assessment tasks:

1:
ONGOING ASSESSMENT

Problem solving, exercises, questions or brief monographic reviews set during the classes responded to individually by the student in the same classes or handed in after to the lecturer giving the class. With these questions, the student must show knowledge of this subject's topics (described in the "brief introduction to the subject" section in this manual). Specifically, the following will be assessed: the right approach to solving the question or problem, correct solution, interpretation of the results and explanation of how the problem, question or monographic review was solved, giving equations or graphs where necessary. The student's knowledge and oral and written communication skills will be scored between 1 and 10 as these will be clear from the questions, debates and monographic reviews.

2:

HYBRID AND OTHER SITTINGS

For hybrid students coming to other sittings or wishing to increase their mark, the assessment consists of a written test (50%) and an oral test (50%) before a tribunal of three lecturers from the subject area. In these tests, the student must display knowledge regarding the topics taught in this module as well as their ability to apply this knowledge to specific problems and situations showing good use of the units system, correct treatment and interpretation of experimental data. This knowledge will be assessed on a scale of 1 to 10. Scientific communication skills will also be evaluated through these tests - on a scale of 1 to 10 - and here correct use of scientific language, audiovisual techniques, graphics, clarity of presentation, etc. will be expected. Both oral and written exams will take place in the language used for the course: English.

Activities and resources

Course methodology

The learning process that has been designed for this course is based on the following activities:

The learning process created for this subject is based on:

Through participatory master classes, go in depth on the tools provided by chemistry for the production of new materials and their assembly and organisation into complex structures with a high degree of order in which the properties can be significantly boosted or modified.

Outline of the Programme

The programme offered to the students to help them achieve the learning results includes the following activities :

1:

Each topic area making up the programme for the module will be presented, analysed and discussed by the lecturer through participatory master classes lasting 50 minutes. The lecturers will provide the students with notes, handouts or summaries of class content prior to the beginning of the class along with the recommended reading for more in-depth understanding of the topic.

2:

Open forum on the basic concepts, research possibilities and laboratory applications. Comparison with real developments. Problem solving, identifying spectra and practical case studies All the above will take place in participatory 50 minute classes.

Course planning

Calendar of actual sessions and presentation of works

This calendar will be published at the beginning of each academic year in the web site of the Faculty of Science (https://ciencias.unizar.es/web/horarios.do). All classes will be in the afternoon.

Bibliographic references of the recommended readings