Máster en Materiales Nanoestructurados para Aplicaciones Nanotecnológicas
66100 - Fundamental properties of nanostructured materials

Course 2013 - 2014

Curso: 1, Semestre: 0, Créditos: 6.0

Basic information

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Recommendations to attend this course

The “Preparation of Nanostructured Materials” module is mandatory and counts for 8 ECTS credits or 200 student work hours. Of these 8 credits, 6 are for theory and 2 correspond to laboratory practicals. The course is given in the first 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 to show the student the various chemical and physical methods for preparing nanostructured materials.

This is an eminently practical module where students analyse, debate and evaluate different nanostructured materials manufacturing methods. The theory classes are accompanied and complemented by four practicals through which the students can see up close in the laboratory the difficulties and advantages of the different preparation methods for these materials, with access to highly specialised equipment that they will be able to use - under supervision of the staff - as there will be so few people per group (3-4 students).

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.

Additional information about this master (grants, events, etc.) can be found on the web site: www.unizar.es/nanomat

Course Schedule and Deadlines

Lectures for this module begin at the start of the academic year and will last approximately four 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 materials and compounds of particular relevance on the nanoscale, noting the degree of advance achieved and the problems still to be solved.

2:
Distinguish between macro, micro and nano systems; identify the physical and chemical tools necessary to work on the nanoscale.

3:
Assess the current legislation on nanostructured materials; analyse the toxic potential and possible effects on health, environment and sustainability.

4:
Identify the scientific and technological possibilities of nanostructured materials: on the one hand, assessing social interest for miniature devices and the new and revolutionary applications for these; on the other hand, recognising the existence of a new scientific and technological context governed by nanoscale laws - the Laws of Quantum Mechanics.

Introduction

Brief presentation of the course

On atomic- and molecular-scale - known as nanoscale - there is a convergence between Physics, Chemistry, Biochemistry, Science of Materials, Engineering and Bioengineering towards the same theoretical principles and experimental techniques. This first module covers the basic concepts of these disciplines so that students understand and take in the more advanced information to be studied in later modules.

The contents of this module are:

Introduction to Nanoscience and Nanotechnology. Nanomaterials vs. macroscopic materials. Introduction to Supramolecular Chemistry. Structure and properties of nanoscopic organic materials (nanotubes, fullerenes, dendrimers, block copolymers...). Physical Chemistry of Surfaces. Colloids, tensoactives, monolayers, micelles, vesicles, capsules. Nanobiomaterials. Biomacromolecules. Optical, electric, magnetic, and mechanical properties of nanomaterials. Nanotoxicology and eco-nanotoxicology.

Competences

General aims of the course

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

Advances in Nanoscience are expected to result in drastic changes in our understanding of the design and fabrication of nanodevices which will make use of the exceptional properties of nanomaterials. In this context, it is believed that Nanotechnology will be, if it is not yet, the XXI revolution due to the numerous societal implications of Nanoscience and applications in daily life (food, textiles, vehicles, nanodiagnosis, nanocure, etc.).

Throughout this first module of the master, students wil be given the needed tools to identify the potential of working at the nanoscale involving a large variety of disciplines including nanophysics, nanochemistry, and nanobiomedine. Students will acquire fundamental knowledge about the state of the art of Nanoscience and Nanotechnology (scientific, social, economics and legal aspects). The course will provide students with tools and skills to interrelate structure, composition, architecture and physical, chemical and mechanical properties of nanomaterials.

Context/Importance of the course for the master degree

As stated before, the main aim of this module is to provide students with a sound theoretical and methodological background that will allow them to understand the fundamentals of the chemistry, physics, materials science, biochemistry, engineering, bioengineering and nanosecurity behind the properties of nanomaterials. This knowledge will guide students in the following modules of the Master.

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

1:
Understanding the state of art of Nanoscience and Nanotechnology, assessing its multidisciplinary nature as well as the social, economic and legal implications.

2:
Understanding the conceptual differences between macro and nano systems, obtaining the necessary theoretical knowledge to acquire understanding of the nanoscale.

3: Identifying materials and compounds of significant relevance at the nanoscale, evaluating the state of the art and recognizing the unresolved issues.

4:
Assessing properties of particular interest in nanostructured materials.

5:
Understanding the importance of the surface effects and the new forces that appear on the nanoscale and their influence on the properties of nanoscopic systems.

6:
Applying acquired knowledge to properly handle nanostructued materials. Students are expected to know the current state of safety regulations and the possible effects of nanomaterials on health, environment and sustainability.

Relevance of the skills acquired in the course

The enormous potential of Nanoscience and Nanotechnology has caught on deeply in politicians, businessmen and society itself creating new demands for specialists at the very highest level in the field. Therefore, a prime objective of this Master's is the creation of professionals with the understanding, knowledge and abilities necessary to exercise as senior professionals in diverse areas (industry - production of new materials, electronics industry, pharmaceuticals, chemistry, aerospace, etc. – consultancy, research, teaching, etc.).

In the context of this Master's, the "*Fundamental Properties of Nanostructured Materials*" module aims to make the student aware of the relevance of Nanoscience and Nanotechnology in the scientific and technological atmosphere of 21st century society. The student will gain the essential tools necessary to be able to study in depth all areas corresponding to the design and creation of new and efficient nanodevices, covering synthesis, processing, characterization and property determination for these devices. At the same time, the student will assess other areas such as sustainability, safety, financial benefits, etc.

Evaluation

Assessment tasks

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

1:
For students choosing Ongoing Assessment:

1.- Written exam (50% of the final result for the module). With this exam the students are expected to demonstrate that they have assimilated the critical approaches presented by their lectures and to prove their ability to resolve problems of interest of Nanoscience and Nanotechnology. The exam will credit students' achievement of these module competences. This written exam consists of:

(a) Theory questions including: (i) topic(s) to be explained and (ii) short answer and/or multiple choice questions. On a scale of 1 to 10, this written test will assess the knowledge of the student regarding the state of the art in Nanoscience/Nanotechnology; electrical, magnetic, optical and mechanical properties of nanomaterials; links between the structure and chemical composition of nanostructured materials; importance of surface effects; and the state of current legislation on Nanoscience and Nanotechnology.

(b) The exam will also contain a section on problem solving and exercises where - on a scale of 1 to 10 - data treatment ability, chemical-physical property assessment, differentiation between macro- and nanoscale, use of appropriate SI units, etc. will be assessed.

2.- Exercise, problem and question solving of matters seen in class and seminars (where the students need to show knowledge of the topic and oral communication skills); in addition, Q&As to be completed by students

following classes (50% of the final result of the module). Through these tests, the results of the learning process will be assessed with regard to the abilities required for the module such as data interpretation, oral and written communication skills, interaction with colleagues and professionals from other areas, etc.

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 of 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, current legislation in the areas of Nanoscience and Nanotechnology, toxicity, nanosafety, etc. 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 aim of this module is to establish the basic principles of Physics, Chemistry, Biology, Science of Materials, Engineering, Bioengineering and Nanosafety necessary to successfully tackle the following modules which have an eminently applied nature.

Therefore, following a general examination of these basic principles through participatory master classes, there will be case and problem analysis activities where these principles can be observed, examined in depth, evaluated and clarified.

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 (preferably via ADD) along with the recommended reading for more in-depth understanding of the topic.

2:

Open forum on the basic concepts and their application. Comparison with real developments. Problem solving and practical case studies. All the above will take place in participatory 50 minute classes.

3:

Completion of individual Q&As. Each student will complete the Q&As that the subject lecturers

give them over the length of the course. The Q&As are to be completed individually by students and sent electronically or handed in to the relevant lecturers. In some cases, the Q&As will be presented and openly debated during class. Here, the students must also show their oral communication skills. Students will receive a reply from the lecturers as a result of the Q&As and there will be a discussion on the areas of discrepancy in the answers.

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