66116 - Fabrication of Micro and Nanodevices

Información del Plan Docente

Academic Year	2018/19
Subject	66116 - Fabrication of Micro and Nanodevices
Faculty / School	100 - Facultad de Ciencias
Degree	539 - Master's in Nanostructured Materials for Nanotechnology Applications
ECTS	5.0
Year	1
Semester	Second semester
Subject Type	Optional
Module	---

1.General information

1.1.Aims of the course

In this optional course, the students will apply the theoretical knowledge acquired in the core courses of the Master programme (production and characterization of nanostructured materials) to real problems, which will allow them to produce micro and nanodevices and evaluate their performance. Thus, they will become aware of the potential applications of Nanotechnology in a more natural way for fields as diverse as molecular electronics, advanced chemical sensing, optical and magnetic hyperthermia, production of nanomaterials by microfluidics...

1.2.Context and importance of this course in the degree

Once the students have a solid theoretical base and have learnt the general ways to prepare nanostructured materials and characterise them, this course is the natural next step. They apply the acquired knowledge, capabilities and skills to the solving of real problems and they get to create their own devices.

Hence, this course will make them more aware, on the one hand, of the potential applications of the discipline they are studying and, on the other, will also make them aware of the real difficulties coming with the application and market possibilities of these devices.

1.3.Recommendations to take this course

"*Fabrication of micro and nanodevices*" is an optional module equivalent to 5 ECTS credits or 125 student work hours. Out of these 5 credits, 1 ECTS is dedicated to the theorethical fundamentals and the remaining (4 ECTS) correspond to laboratory practicals. The course is given in the second term of the academic year.

The objective of this module is that the students can make their own nano- or microdevices, experiencing the potential applications and becoming familiar with the practical and real application of the material studied in the previous modules.

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This module is mainly practical and the students will make and characterize their own devices, evaluating the practical applications of these. The theory classes will focus on explaining the theory upon which the devices the students will make in the laboratory is based. The students will have access to sophisticated production and characterization equipment.

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.

2.Learning goals

2.1.Competences

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

- Understand and successfully prepare micro and nanodevices.
- Design and create nanodevices, assessing real difficulties in their production and in the requirements for these to reach the marketplace.

2.2.Learning goals

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

- Identify and, with rigour, describe some of the recent specific developments in research that have led to nanotech applications.
- Find opportunities to apply theory and knowledge of the phenomena taking place at the nanoscale for the making of devices and specific applications.
- Assess the true difficulties that come with the practical pursuit of an idea or concept.

2.3.Importance of learning goals

This course involves the application of the theoretical knowledge and the practical and "hand on" skills acquired by the student to the design and production of nanodevices that may have real, significant applications in the current market. Furthermore, we trust that this subject - in which the students make nanotech devices - will contribute to motivating and encouraging them to face new challenges and to awaken new interests.

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

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

- For students choosing **continuous assessment** (attendance to at least 80% of this module lectures and practicals is

required):

- Assessment of the practical credits of the course (80% of the final mark). The lecturers involved will score from 1 to 10: the abilities in the lab, fundamental knowledge on which the practical is based, and/or the Q&As and reports handed in by the students on their laboratory results and the interpretation of these. Special attention will be paid to checking that students have acquired the necessary abilities from these practical sessions, i.e. handling of nanomaterial production techniques, recognition of experimental difficulties in these processes, problem, risk and difficulty evaluation, interpretation of results obtained, professional presentation of laboratory-acquired results and written communication ability with specific language appropriate to the topic under consideration.
- The lecturers involve in the theoretical fundamentals supporting the laboratory sessions will assess problem solving, exercises and questions during the classes answered by the student at that time or later according to the lecturer's indications (20% of the final mark).

A minimum mark of 4 out of 10 is needed for each of the two parts of the assessment to pass the subject. In any case, the average over the two sections must be at least 5 out of 10 to pass the subject. Plagiarism (the illicit copying of another person's work, especially written content, for presentation as one's own) is not allowed.

- For those students that did not pass the continuous assessment or wish to increase their mark, **the global** assessment comprises:

- Firstly, there will be a multiple choice test which must be passed before going into the laboratory. Here the judgement is on whether or not the student is ready to respect the laboratory safety norms and if the student is able to manage the instruments involved in the practical test. This is an elimination test which can only be passed with a score of 8 out of 10. This first test counts for 5% of the final mark. Once the test is passed, the student begins the practical exam. This consists of an experiment in which the student must show the capability to plan the necessary experiments given the objectives to be achieved. These experiments must be performed adequately, correctly using the corresponding instruments (an expert will at all times be supervising and will halt the exam if this person sees that the student is endangering the equipment used or their own safety). This part counts for 65% of the final mark.
- Lastly, the student must interpret the data obtained and write a report in which the results obtained are analyzed and the main conclusions given. A score of between 1 and 10 will be given for the scientific quality of the report presented and the student's communication skills. This report counts for 30% of the final mark.

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The aim of this module is that the students can make their own nano- or microdevices, experiencing the potential applications and becoming familiar with the practical and real application of the material studied in the core courses. Therefore, following a general examination of these methods through lectures and case studies, , there will be laboratory practice sessions where the lecturer will supervise the production of micro and nanodevice. Students will acquire the knowledge necessary to successfully fabricate and/or characterize the micro-nanodevices to evaluate its performance.

The methodology followed in this course is oriented towards achievement of the learning objectives. Students are expected to participate actively in the class throught the semester. Classroom materials will be available via Moodle. These include a repository of the lecture notes used in class, the description of the practicals sessions, the course syllabus, as well as other course-specific learning materials. Further information regarding the course will be provided by the coordinator of the course on the first day of class.

4.2.Learning tasks

The programme offered to the students to help them achieve the learning results includes the following activities:
- Each micro and nanodevice to be made will be presented, analysed and discussed by theory sessions of 50 min. 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.

- Laboratory practice sessions through which the students will face real problems in the production and end properties of the micro-nanodevice built. Thanks to the work with their colleagues in practical groups, the students will develop group work skills.

4.3.Syllabus

The course will address the following topics:

- Microsensors
- Microcantilevers
- Micromembranes
- Optical biosensors
- Electrochemical sensors
- Organic light-emitting diodes (OLEDs)
- Plasmonic Nanoparticles synthesized in Microreactors
- Magnetic Contrast Agents
- Quantum Dots

4.4.Course planning and calendar

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). Additional information could be found at www.unizar.es/nanomat.

In addition, the google calendar for this course will be shared with the students for a more efficient and effective communication.

The course starts at the end of course 66104 "Characterisation II: Advanced microscopies" (around the mid of April) and continues for about 4 teaching weeks.

Further information concerning the timetable, classroom, assessment dates and other details regarding this course, will be provided on the first day of class by the coordinator of the course.

4.5.Bibliography and recommended resources