Universidad Zaragoza

Academic Year/course: 2023/24

66104 - Characterisation II: Advanced microscopies

Syllabus Information

Academic year: 2023/24
Subject: 66104 - Characterisation II: Advanced microscopies
Faculty / School: 100 - Facultad de Ciencias
Degree: 539 - Master's in Nanostructured Materials for Nanotechnology Applications
ECTS: 6.0
Year: 1
Semester: Second semester
Subject type: Compulsory
Module:

1. General information

This course, "Characterization II: Advanced Microscopies", teaches students about the various techniques available for characterizing nanostructured materials and their properties, including morphological, structural, analytical, optical, electric, and magnetic properties. The course covers advanced microscopes such as electronic, dual-beam, and scanning probe microscopes, which offer nanometric resolution and the ability to analyze materials at the atomic and molecular scale. Students will gain theoretical knowledge and practical experience using specialized scientific instruments to characterize nanostructured materials.

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

2. Learning results

- Understand the theoretical and practical basics of electron, scanning probe and "dual-beam" microscopies.
- Be able to plan experiments making use of the advanced microscopes, applying the materials preparation techniques for their observation at the nanometric scale.
- Be able to differentiate among the contributions of a morphological, structural and analytical nature at the nanometric scale based on the different microscopes.
- Identify specific phenomena and problems for which this kind of tools can provide vital information.
- Assess the observation difficulties linked to the resolution of the tools and the environmental conditions in which the measurements are taken.
- Identify the scanning probe microscopes - AFM and STM - as nanotools with which to handle the substance at the nanometric scale.

3. Syllabus

The course will address the following topics:

- Introduction to electron and scanning probe microscopy.
- Scanning electron microscopy.
- Transmission electron microscopy (image and diffraction).
- Analytical techniques linked to electron microscopy: energy dispersive X-ray spectroscopy and electron energy loss spectroscopy.
- Atomic and magnetic force microscopy. Scanning tunnelling microscopy.
- Surface spectroscopy.
- Other advanced optical microscopes: confocal and near-field

4. Academic activities

Lectures (3 ECTS) that cover the course topics, with accompanying notes, handouts, and open forum activities to reinforce the concepts.

Laboratory sessions (3 ECTS) involve practicals in the characterization of nanostructured materials, with task guidelines and

visits to LMA facilities.

Assignments. Q&As at the end of each topic are to be completed individually and presented in class, with monographic reports on specialized topics assigned to groups (2-3 students) for oral presentation.

Autonomous work is expected, with students spending approximately 100 hours to study, solve problems, prepare for lab sessions, assignments and exams.

Tutorials are also available to solve questions and clarify any unclear course content.

5. Assessment system

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

1.- Individual Assessments including exercises, problem and question solving of matters seen in class and seminars (25% of the final result for the module).

2.- A monographic project prepared by groups (25 % of the final result for the module) related to some of the topics included in the module descriptors. e).

3.- Practical Assessment (50% of the final result for the module) where the knowledge, instrument handling skills, accuracy, attention to detail, and ability to solve problems are evaluated. Lectures may also ask the students to write reports on their laboratory results.

For students that did not pass the ongoing assessment or wish to increase their mark **Global Assessment** comprising a written test (25% of the final mark), a viva with a board of examiners (25% of the final mark) and a practical exam (which counts for the remaining 50% of the mark).

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