Universidad Zaragoza

Academic Year/course: 2024/25

60649 - Advanced Inorganic Materials

Syllabus Information

Academic year: 2024/25
Subject: 60649 - Advanced Inorganic Materials
Faculty / School: 100 - Facultad de Ciencias
Degree: 540 - Master's in Industrial Chemistry
ECTS: 3.0
Year: 1
Semester: Second semester
Subject type: Optional
Module:

1. General information

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

The general objective of the subject is that students deepen their knowledge of inorganic materials, their chemical composition, structure, methods of obtaining and processing, their properties and their main applications.

These approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations Agenda 2030 (https://www.un.org/sustainabledevelopment/es/), so that the acquisition of the learning results of the subject provides training and competence to contribute to some extent to their achievement:

Goal 7: Affordable and Clean Energy

Objective 9: Industry, innovation and infrastructure

Objective 12: Responsible production and consumption

2. Learning results

Upon completion of this subject, the student will be able to:

Know the chemical nature, transformation methods and properties of a selection of advanced inorganic materials.

Know the application of these materials to devices of great importance in the industrial sector.

Have criteria on the choice of materials in different technologies according to properties and application conditions.

Prepare, present and defend reports.

3. Syllabus

Batteries

Basic principles.

Primary batteries: zinc-carbon, alkaline, button, lithium, oxyride. Applications.

Secondary batteries: lead-acid, nickel-cadmium, nickel-metal hydride, alkaline, lithium. Applications.

Current and potential applications of batteries: portable electronic devices. Hybrid and electric vehicles. Medical applications. Causes of battery failure.

Battery disposal/recycling

Magnetic materials

Introduction.

Microstructure and magnetic domains.

Magnetization processes and magnetization curves.

Magnetically hard and soft materials.

Shape anisotropy.

Magnetic nanoparticles.

Magnetoresistance.

Giant and colossal magnetoresistance.

Examples and applications of magnetic materials

Hard magnetic materials: permanent magnets.

Soft magnetic materials.

Magnetic storage.

Magneto-optical storage.

Molecular magnets.

Surface treatment of metals

Thermal and thermochemical treatments.

Electrochemical methods.

Chemical passivation.

Physical vapor deposition, chemical vapor deposition and ion implantation.

Advanced alloys

Superalloys.

Porous metals.

Shape memory alloys.

Metallic glass.

Other advanced materials

4. Academic activities

The program offered to the student to help them achieve the expected results includes the following activities:

Master classes with student participation (25 h). The most important concepts will be explained. The student should complement the explanations with the readings recommended in the bibliography.

Teaching assignments. Students, individually or in groups, will prepare a paper on a topic related to the subject.

Seminars(5 h). They will be organized in 1-hour sessions. In them, the students will work on different problems of application of the materials or will defend the work mentioned in the previous section by means of an oral presentation

5. Assessment system

First Call

1. Completion of a paper, and oral presentation of topics related to the subject, as well as teaching a class, in coordination with the teacher. Value: 100% of the total grade.

Second Call

1. Written test where the knowledge acquired throughout the subject will be assessed. Value: 100% of the final grade.

6. Sustainable Development Goals

7 - Affordable and Clean Energy
9 - Industry, Innovation and Infrastructure
12 - Responsible Production and Consumption