

Academic Year/course: 2022/23

60649 - Advanced Inorganic Materials

Syllabus Information

Academic Year: 2022/23

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

2. Learning goals

3. Assessment (1st and 2nd call)

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as:

- Theory sessions with practical cases (2.5 ECTS).
- Seminars (0.5 ECTS).
- Tutorials to solve doubts and follow-up of students' work.

4.2. Learning tasks

The course includes the following learning tasks:

- Theory sessions (25 h). The necessary materials for each topic will be given to the students so they can review it in detail before the corresponding session. Lecture notes will explain the most important concepts although the student should complement those explanations with the recommended bibliography.
- Assignment. The students, individually or in group, will prepare a work on a topic related to the course.
- Seminars (5 h). They will be organized in one-hour sessions. In them, the students will solve problems of materials application, and they will defend through an oral presentation their individual/group assignment.

4.3. Syllabus

The course will address the following topics:

Topic 1. Batteries

- 1.1. Characterization of the parameters of batteries.
- 1.2. Primary batteries: zinc carbon, alkaline, button, lithium, oxyride. Applications.

- 1.3. Secondary batteries: lead-acid, nickel-cadmium, nickel-metal hydride, alkaline, lithium. Applications.
- 1.4. Current and potential applications of batteries: Portable electronic devices. Hybrid and electrical vehicles. Medical applications.
- 1.5. Causes of battery failure: loss of capacity, increasing internal resistance, self-discharge, premature disconnection ...
- 1.6. Disposal / Recycling of batteries: Safety issues and recycling. EU Battery Directive. Classification. Recycling processes ...
- 1.7. The future of the batteries.

Topic 2. Magnetic Materials

- 2.1. Introduction to magnetic materials.
- 2.2. Microstructure and magnetic domains.
- 2.3. Processes of magnetization and magnetization curves.
- 2.4. Magnetically hard and soft materials.
- 2.5. Shape anisotropy.
- 2.6. Magnetic nanoparticles.
- 2.7. Magnetoresistance.
- 2.8. Giant and colossal magnetoresistance.

Topic 3. Examples of magnetic materials and applications

- 3.1. Hard magnetic materials: permanent magnets.
- 3.2. Soft magnetic materials.
- 3.3. Magnetic storage.
- 3.4. Magneto-optical storage.
- 3.5. Molecular magnets.

Topic 4. Surface treatment of metals

- 4.1. Heat treatments.
- 4.2. Thermochemical treatments.
- 4.3. Electrochemical methods: anodizing, electroplating.
- 4.4. Chemical passivation.
- 4.5. Physical vapor deposition, chemical vapor deposition and ion implantation.

Topic 5. Advanced Alloys

- 5.1. Superalloys.
- 5.2. Porous metals.
- 5.3. Shape memory alloys.
- 5.4. Metallic glasses.
- 5.5. Metal hydrides.

Topic 6. Other advanced materials

4.4. Course planning and calendar

Further information concerning the timetable, classroom, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the Faculty of Science <http://ciencias.unizar.es/>, <http://ciencias.unizar.es/web/horarios.do>

4.5. Bibliography and recommended resources

- Callister, William D., jr.. Introducción a la ciencia e ingeniería de los materiales / William D. Callister, jr ; [versión española por Pere Molera Solà y Marc J. Anglada Gomila] . - [1ª] ed. en español, reimp. Barcelona [etc.] : Reverté, 2007
- Smith, William F.. Fundamentos de la ciencia e ingeniería de materiales / William F. Smith ; traducción, Alicia Larena Pellejero . - 3ª ed. Madrid [etc.] : McGraw-Hill, D.L. 1998
- Smith, William F.. Fundamentos de la ciencia e ingeniería de materiales / William F. Smith, Javad Hashemi ; revisión técnica Ramón Esquivel González, Arturo Barba pingarrón , [traductor, Gabriel Nagore Cázares] . - 5ª ed. México D. F. : McGraw-Hill Interamericana, cop. 2014
- Gil Berceiro, J.R.. Introducción al conocimiento de los materiales y a sus aplicaciones. UNED. 2008

- Smart, Lesley. Solid state chemistry : an introduction / Lesley E. Smart, Elaine A. Moore . - 3rd ed. Boca Raton [etc.] : Taylor & Francis, cop. 2005
- Geddes, B.. Superalloys: Alloying and Performance . ASM International. 2011