60461 - Chemistry of advanced materials

Información del Plan Docente

Academic Year	2016/17
Academic center	100 - Facultad de Ciencias
Degree	543 - Master's in Molecular Chemistry and Homogeneous Catalysis
ECTS	2.0
Course	1
Period	Second semester
Subject Type	Optional
Module	---

1.Basic info

1.1.Recommendations to take this course

It is advisable prior knowledge (bachelor's degree level in Chemistry) on Inorganic Chemistry and Organic Chemistry. Basic knowledge on Materials Science is recommended.

1.2.Activities and key dates for the course

The information about schedules, calendars and exams is available at the websites of the Sciences Faculty, https://ciencias.unizar.es/calendario-y-horarios , and the Master, http://masterqmch.unizar.es .

2.Initiation

2.1.Learning outcomes that define the subject

To recognize advanced materials of current interest of both organic and inorganic nature.

To identify the involvement of Chemistry in the development of advanced materials.

To know the basics of rational design of these materials.

To apply novel chemical principles to the synthesis and preparation of advanced materials.

To evaluate the most suitable techniques for the preparation and characterization of advanced materials.

2.2.Introduction

The preparation of materials to meet technological demands of the society is an important area of work in which a Chemist should interrelate the synthetic and structural knowledge acquired in their previous training. The development of new materials is based on the knowledge of the relationship between chemical structure and physical properties associated with a particular application, as well as the knowledge of the synthetic strategies that allows obtaining the required material. In this course, the specific synthetic methods for the preparation of chemicals conventionally used for

materials will be revised and how the structural design determines the synthetic methodology and the final processing of the material.

3.Context and competences

3.1.Goals

To interrelate the chemical structure and the properties in the design of advanced materials.

To identify the specific synthetic methodologies of materials and how to approach their preparation and processing depending on the required optimal structure.

3.2.Context and meaning of the subject in the degree

The course is part of the optional module *Horizons in Molecular Chemistry and Catalysis* . It is a four-month teaching course given in the second semester of the academic year with a workload of 2 ECTS.

Because knowledge of the synthetic principles and of the molecular structure are key issues for preparing materials, the course aims to apply them to the field of materials. Therefore, the course requires of the knowledge acquired in the compulsory courses of the Master and complements other optional curses such as Supramolecular Chemistry, Advanced Structural characterization techniques and is useful for some others like Chemistry on the border frontier with biology.

3.3.Competences

To design of materials with the appropriate molecular structure to meet specific properties.

To be able to propose appropriate synthetic strategies as a function of the molecular or macromolecular structure of the material.

Relate concepts of Organic and Inorganic Chemistry, Macromolecular Chemistry and Nanoscience in the design of advanced materials.

To anticipate advanced applications for organic and inorganic materials.

To be able to select characterization techniques for the study of the materials in both its synthetic process and structural or physical properties characterization.

3.4.Importance of learning outcomes

Technological development implies a demand for new materials. This demand requires of an interdisciplinary response that implies adequate structural design and a viable synthesis of these new materials. This course aims to raise awareness of the importance of chemistry in this process From the results of this course, starting from significant examples, students will expand their knowledge of materials while will implement previous skills and training either acquired in the degree or compulsory courses of the master, to address problems related to the design and development of advanced materials.

60461 - Chemistry of advanced materials

4.Evaluation

The ongoing assessment of the course will be based on the following activities:

A1.- Preparation, presentation and defense of a practical case based on a scientific paper or a specific topic. The critical discussion/presentation will be taken into account. Rated as 30% of the final mark

A2.- Written test based on theory questions. Rated as 70% of the final mark

For those students that did not pass the ongoing assessment or wish to increase their markit will be a global exam during the official calls in February and September. The assessment will consist of a written test based on theory questions, problems and case analysis. Also, the preparation, presentation and defense of a practical case will be required. Final mark will be calculated as follows:

70% of the written mark + 30% of the practical case

Students with scores higher than 5 over 10 in A2 activity in the ongoing assessment can maintain their qualification for this global examination in June or September.

The number of official examination calls per registration and their use will be subjected to the statements of the *Regulation of Permanence in Master Studies and* *Regulation of the Learning Assessment* . The latest document will also regulate the general design and scoring criteria of the assessment activities, as well as the exam schedules and timetable for the post-examination review.

5.Activities and resources

5.1.General methodological presentation

Interactive lectures (1.5 ECTS)

Seminars and problem-solving sessions (0.5 ECTS)

The active participation of the student will be promoted from a critical analysis of the theoretical knowledge, in particular, by proposing problem and practical case activities. The student must prepare a case of study that will by supervised by the lecturer. This activity will imply searching for the appropriate bibliography, preparation, presentation and defense of the project.

5.2.Learning activities

Interactive lectures

Problem solving and case analysis classes

Supervised projects

Tutorials

60461 - Chemistry of advanced materials

5.3.Program

The lecture topics to be covered are as follows:

I. General Aspects

1. Introduction to advanced materials

Definition and classes of materials. Molecular design of materials. From the molecule to the material. Basic experimental techniques for the characterization of materials: General aspects.

II. Synthesis of advanced materials. Examples of applications.

2. Fundamentals of the synthesis of macromolecules

Macromolecular chemistry. Conventional polymerization techniques. Living polymers. Fundamentals of macromolecular engineering. Controlled radical polymerization: ATRP and RAFT. Ring opening polymerization and enzymatic polymerization: development of biodegradable polymers and from natural resources.

3. Design and functionalization of macromolecules

Design of copolymers: control of topology and composition. Hyperbranched macromolecules. Dendrimers. Functionalization of macromolecules. Development of advanced polymers.

4. Development of nanoparticles: inorganic, organic and hybrid nanoparticles

Types of nanoparticles and properties. Synthesis of nanoparticles. Functionalization of nanoparticles and applications.

5. Porous materials

Microporous, mesoporous and macroporous materials. Zeolites and other porous materials. Mesoporous and macroporous materials. Metal-organic frameworks (MOFs). Applications.

5.4.Planning and scheduling

The information about schedules, calendars and exams is available at the websites of the Sciences Faculty . Dates for the supervised project presentations will be according to the schedule to be announced well in advance.

The students will be provided with different scholar material either at reprography or through the University's web tool: https://moodle2.unizar.es/add .

5.5.Bibliography and recomended resources

Basic bibliography

60461 - Chemistry of advanced materials

- Materials chemistry (2ª edición). B. D. Fahlman. Ed. Springer, 2011.
- Controlled and Living Polymerizations. From Mechanisms to Applications. A. H. E. Müller, K. Matyjaszewski. Ed. Wiley-VCH, 2009.

Complementary bibliography

- Nanoparticles: from Theory to Application. G. Schmidt. Ed. Wiley-VCH, 2004.
- Nanomaterials. An Introduction to Synthesis, Properties and Applications. D. Vollath. Ed. Wiley-VCH, 2008.
- Macromolecular Engineering. K. Matyjaszewski, Y. Gnanou, L. Leibler. Ed. Wiley-VCH, 2007
- Chemistry of Zeolites and Related Porous Materials: Synthesis and Structure. R. Xu, W. Pang, J. Yu, Q. Huo, H. Chen. Ed. Wiley & Sons, 2007.
- Metal-Organic Framework Materials. L. R. MacGillivray, C.M. Lukehart. Ed. Wiley & Sons, 2014.

Sitios Web

- core.materials.ac.uk
- http://www.cmu.edu/maty/crp/index.html