Universidad Zaragoza

Academic Year/course: 2024/25

69707 - Materials and surface treatments for prostheses and implants

Syllabus Information

Academic year: 2024/25
Subject: 69707 - Materials and surface treatments for prostheses and implants
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 633 - Master's Degree in Biomedical Engineering
ECTS: 3.0
Year:
Semester: Second semester
Subject type: Optional
Module:

1. General information

The objective of the subject is to provide the student with the knowledge that the interaction of biomaterials with their environment is done through their surface which can be intentionally altered to have control over their behaviour in applications such as implants and prostheses. This subject describes the main techniques used to modify the surfaces of biomaterials. The main methods used to characterise these surfaces from a structural and microstructural point of view are also discussed. This makes it possible to obtain information on the modification carried out and thus to correlate it with the benefit or deterioration of their performance in biomedical applications.

2. Learning results

1) To understand the importance of the surface of biomaterials for their behaviour.

2) To know the main techniques for surface modification of biomaterials by surface treatments and coatings, and to understand the rationale for their use in a specific application.

3) To know the main techniques to characterize the composition, structure, microstructure and properties of surfaces and coatings.

4) To deepen in some applications of the previous techniques in the field of biomedical engineering.

3. Syllabus

Introduction

1.1- Surface engineering

1.2- Types of biomaterials: Interaction with the biological environment. Adverse effects

1.3- Examples of biomedical applications: Importance of surface area

Surface treatments

2.1- Plasma-based technologies

2.2- Ionic implantation

2.3- Laser surface modification

2.4- Thermochemical treatments

2.5- Mechanical treatments

Coatings

3.1- Plasma polymerization

3.2- Vapor Phase Deposition: PVD and CVD

3.3- Thermal projection

3.4- Sol-gel

3.5- Electrochemicals

Surface characterization techniques

4.1- Composition (XPS, AES, SIMS, EDS)

4.2- Microstructure (electron microscopy, AFM)

4.3- Roughness (profilometry, AFM)

4.3- Coating thickness (calotest, ellipsometry)

4.4- Mechanical properties (hardness, elastic modulus, tribological)

4. Academic activities

Master class: 18 hours

Presentation of the topics combined with examples of commercial products.

Problem solving and case studies: 4 hours

Solving of exercises and discussion of cases extracted from scientific publications.

Laboratory practices: 6 hours

Selection of materials for biomedical engineering applications (CES software), coating technique (anodizing) and visit to characterization equipment.

Practical work: 12 hours of personal work**.**

Study of a scientific article and preparation of a presentation document.

Personal study:30 hours

Assessment tests: 1 hour of written exam + 2 hours of defence and discussion of papers.

5. Assessment system

The evaluation consists of the following parts:

E1: Final exam (30% of the final grade (NF)): Multiple-choice test of 20 to 30 questions.

E2: Academic paper (TA) (30% of the NF): This TA consists of analysing a research paper given to each group of students and preparing a paper for presentation.

E3: Presentation and discussion (20% of the NF): The TA will be presented to teachers and students.

E4: Practical sessions (20% of the NF): reports and laboratory work will be evaluated.

If the practical sessions and their reports are not completed, part E4 will be replaced by a practical exam (E5) (written and laboratory) to be taken together with E1, E2 and E3 on a day and time determined by EINA.

In order to calculate the NF, at least 40% of the maximum grade for each of the parts must be obtained. Failure to pass this minimum in one or more of these parts will result in a failing grade. ~~and the student will have to pass this (these) part(s) in the second call. The parts with a grade equal to or higher than 40% will be kept for the second call.~~

6. Sustainable Development Goals

9 - Industry, Innovation and Infrastructure