69314 - Nano-diagnosis

Información del Plan Docente

Academic Year	2016/17
Academic center	110 - Escuela de Ingeniería y Arquitectura
Degree	547 - Master's in Biomedical Engineering
ECTS	3.0
Course	1
Period	Second semester
Subject Type	Optional
Module	---

1.Basic info

1.1.Recommendations to take this course

1.2.Activities and key dates for the course

2.Initiation

2.1.Learning outcomes that define the subject

2.2.Introduction

3.Context and competences

3.1.Goals

3.2.Context and meaning of the subject in the degree

3.3.Competences

3.4.Importance of learning outcomes

4.Evaluation

5.Activities and resources

5.1.General methodological presentation

The learning method used is based on the cooperative work of the teacher and the student. The method will follow the traditional approach based on lectures but supported by the active participation of the students. Therefore, participation and discussion during the lectures will be promoted.

5.2.Learning activities

The learning process used during the lectures will be based on:

69314 - Nano-diagnosis

A02 (classroom lectures) 26 hours of class where the student will learn through their participation in the attainment of knowledge by gathering information and processing it and by solving problems and answering questions that the teacher will propose during the lectures. The professor will describe the main contents of the course during those lectures. This activity will take place in the classroom. Student's attendance is strongly recommended.

A01 Students activities including assignments, evaluations, elaboration of projects, public defenses and personal study will be required 49 hours of work. Those training activities will be proposed in order to reach the learning results above proposed achieving the designed abilities that the student must acquire.

The research project will have the structure of a scientific paper with the following structure:

-Title

-Author

-Abstract: With no more than 250 words the student should summarize the content described in the paper and its implications in the Nanobiomedical field.

-Introduction: 1 or 2 paragraphs, between 250 to 750 words defining and describing the topic of the review paper.

- Review of the state-of-the-art: There is not wording limitation in this section. This section will review the most relevant advances in the field related to the topic, highlighting those that supposed a breakthrough in the area. Future directions and implications for the coming years should also be described.

-Conclusions: A summary of the main conclusions of the work. A total of 1 or 2 paragraphs with a maximum of 250-750 words will be required.

-Bibliography: Main, relevant references used for the preparation of the manuscript.

The student will give a talk summarizing the main aspects of his/her work in a public defense.

A3: Tutorship: Tutoring time to discuss with the professor in charge of the course all the contents and aspects related to the course in order to solve any question or doubt that he/she might have will be at the student's disposal.

A4: Evaluation assessment . Writing exam. The relevant information about the exam is described in section 4 (Global evaluation).

A5: Practical laboratory work. The student will carry out a practical laboratory work entitled: Synthesis of gold nanoparticles and their application in detection. To this end the student will synthesize monodisperse spherical gold nanoparticles stabilized with citrate, with high control of their size (2-100 nm). The surface plasmon dependence on the size will be applied to detect ionic strength changes in solution.

5.3.Program

The following activities are offered to the students in order to achieve the learning process results...

69314 - Nano-diagnosis

A) Theory and contents of the course.

Section 1. General concepts on biosensors. Components of a biosensor. Classifications of biosensors. Characteristics of a biosensor: selectivity, sensitivity, reliability, service life, analysis time, etc. Why nano? Advantages of the biosensors based on nanostructured materials and nanoparticles over other stablished biosensors.

Section 2. Biosensors base on nanostructured materials. Optical biosensors: Surface plasmon resonance biosensor and interferometric bbiosensor. Electrical biosensors: semiconductor nanowires, nanodevices based on carbon nanotubes. Mechanical nanobiosensors: acoustic nanobiosensors and nanobiosensors based on cantilevers. Physical mechanisms of operation. Integration in microfluidics platforms or in "lab-on-a-chip".

Section 3. Biosensors based on nanoparticles. General concepts on the methodologies used for the synthesis of nanoparticles (gold nanoparticles, magnetic nanoparticles and quantum dots) will be introduced. Strategies for the transfer of nanoparticles synthesized in an organic solvent to an aqueous solution will be discussed. Techniques for the physico-chemical characterization of nanomaterials will be introduced. Finally strategies will be discussed to make use of the physico-chemical properties of nanoparticles to develop new detection strategies or to improve existing ones.

Section 4. Application of nanobiosensors in clinical diagnosis: Examples of nanosensors for the fast, precise and sensitive detection of pathogenic microorganisms, disease related biomarkers or single-base mutations in DNA, with extremely low sample requirements.

Section 5. Applications of nanobiosensors in environment control. Examples of nanobiosensors capable of detecting diverse classes of organic pollutants such as pesticides, agrochemicals, micotoxines, etc. in diverse media such as water, food, etc. will be introduced.

Section 6. Perspectives of the future applications of biosensors. Perspectives of the use of nanobiosensors in biomedical applications in the following years will be discussed.

Section 7. Market insights. Nanobiosensors market. Commercially available biosensors and main companies in their production and distribution.

B) Practical laboratory work

The student will carry out a practical laboratory work entitled: "Synthesis of gold nanoparticles and their application in detection". To this end the student will synthesize monodisperse spherical gold nanoparticles stabilized with citrate, with high control of their size (2-100 nm). The surface plasmon dependence on the size will be applied to detect ionic strength changes in solution.

5.4.Planning and scheduling

The course calendar is defined by the EINA (Engineering School calendar) and they will be posted in the EINA website as well as in the Master website (http://www.masterib.es). Deadlines for project presentation or to submit the required assignments will be posted in the learning platform moodle (https://moodle.unizar.es/) or in the Alfresco server.

The practical laboratory work session will find place in the installations of the Instituto de Nanociencia de Aragón (INA) at the Edificio I+D del Campus del Rio Ebro, calle Mariano Esquillor S/N (lab. 8.1.2). Day and time will be agreed among all the participants without alteration of their participation in other subjects.

69314 - Nano-diagnosis

5.5.Bibliography and recomended resources

BB	Banica, Florinel-Gabriel. Chemical sensors and biosensors : fundamentals and applications / Florinel-Gabriel Banica ; editorial advisor Arnold George Fogg Chichester : John Wiley & Sons, cop. 2012
BB	Nanobiotechnology Inorganic Nanoparticles vs Organic Nanoparticles. Edited by Jesus M. de la Fuente and V. Grazu
BC	Gold nanoparticles: interesting optical properties and recent applications in cancer diagnostic and therapy. Por: Huang, Xiaohua; Jain, Prashant K.; El-Sayed, Ivan H.; et al. En: NANOMEDICINE Volumen: 2 Número: 5 Páginas: 681-693 Fecha de publicación: OCT 2007
BC	Nanomedicine-Challenge and Perspectives. Por: Riehemann, Kristina; Schneider, Stefan W.; Luger, Thomas A.; et ál. En: ANGEWANDTE CHEMIE-INTERNATIONAL EDITION Volumen: 48 Número: 5 Páginas: 872-897 Fecha de publicación: 2009.

LISTADO DE URLs:

Gold nanoparticles in nanomedicine: preparations, imaging, diagnostics, therapies and toxicity. Por: Boisselier, Elodie; Astruc, Didier. CHEMICAL SOCIETY REVIEWS Volumen: 38 Número: 6 Páginas: 1759-1782 Fecha de publicación: 2009 (solo usuarios UNIZAR) [http://pubs.rsc.org/en/content/articlelanding/2009/cs/b806051g#!divAbstract]

Multifunctional Magnetic Nanoparticles: Design, Synthesis, and Biomedical Applications. Por: Gao, Jinhao; Gu, Hongwei; Xu, Bing. ACCOUNTS OF CHEMICAL RESEARCH Volumen: 42 Número: 8 Páginas: 1097-1107 Fecha de publicación: AUG 2009 (solo usuarios UNIZAR) [http://pubs.acs.org/doi/abs/10.1021/ar9000026]