UNIVERSIDAD PONTIFICIA ICAI ICADE COMILLAS MADRID

ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA

DIM-OPT-432 Nanotechnology

SEMESTER: Spring

CREDITS: 3 ECTS (2 hrs. per week)

LANGUAGE: English

DEGREES: IEM

Course overview

Nanostructures are important from the standpoint of science and technology. Nanostructures according to their dimensions and applications. Manufacturing and characterization methods. Current state of the global energy sector from the point of view of transformation, production, consumption and environmental effects. Characteristics of nanotechnology applications for the conversion and production processes, storage and energy savings. Evolution of nanotechnology applications in optoelectronics and the design and manufacture of new light source.

Prerequisites

There are not any prerequisites needed to study the subject. However students are expected to have an understanding of basic chemical and physical concepts, as supplied by Chemistry, Materials Science, Mechanics and Thermodynamics, an equivalent course or provide evidence of equivalent capabilities.

Course contents

Theory:

1. Why nanostructures?. Scientific knowledge of the matter: From the macro--scale to nano-scale. Nanoscience or nanotechnology? Effects of confinement: energy levels. Properties of nano---objects. Effect of classical and quantum size. Emergency and convergence of nanotechnology. Multidisciplinary nature of nanotechnology.
2. Nanostructures by their sizes. Materials 3D. Materials 2D (with confinement effects in one direction). Materials 1D (with confinement effects in two directions). Materials 0D (effects of confinement in three directions).
3. Nanostructures by its applications. Electronics. Photonics. Aerospace. Biostructures. Medicine and Health. Controlled distribution of drugs. Image

Processing. Cosmetics. Genomics, Proteomics and Bioinformatics. Surgery and Implants.

4. Characterization methods. Structural. Electrical. Mechanics. Optics
5. Nanofabrication. Top---down techniques: descending or "top---down". Bottom---up techniques: ascending, or "bottom---up". Hybrid Techniques and nano---micro---macro integration
6. Nanomaterials for energy production and conversion. Photovoltaic Solar Energy. Solar Thermal Energy. Hydrogen Conversion. Thermal Energy and Bioenergetics.
7. Nanomaterials for energy storage. Rechargeable batteries. Hydrogen Storage. Supercapacitors.
8. Nanomaterials for saving energy. Insulation. Combustion Processes. Lighter and stronger materials
9. Nanomaterials for new sources of light. Optoelectronics. More efficient light sources. Light sources with higher lighting capacity

Laboratory:

There will be four 2-hour sessions

P1. Silver nanoparticles synthesis
P2. Graphene production: mechanical and chemical processes.
P3. Nanocharacterization. AFM and STM.
P4. Simulation of nanostructures

Textbook

- Class notes and pdf versions of slides. Journal articles
- Ben Rogers, Sumita Pennathur Jesse Adams. Nanotechnology; Understanding Small Systems. Second Edition. CRS Press. 2011
- Susana Horning Priest. Nanotechnology and the Public: Risk Perception and Risk Communication. First Edition. CRS Press. 2012.

Grading

- 40% comes from project report and an oral presentation at the end of the course
- 40 % Final exam
- 20% comes from daily assessment and laboratory.

Additional evaluation during July (Retake):

- 100% from an written examination