
Materia: NANOSTRUCTURED MATERIALS

Duración	Sesiones/semana	Carga semanal	Semestre
16 semanas	2	3 hrs	Variable

Profesores que han impartido el curso: *Dr. Velumani Subramaniam*

Propósitos: Provide an introduction to the synthesis and characterization of various nanostructured materials for its device applications.

In this course it is intended to introduce the synthesis, characterization and applications of materials functioning at nano scale - meaning a billionth (1×10^{-9}) of a meter. Even though the word nanotechnology is relatively new, the existence of functional devices and structures of nanometer dimensions is not new, and in fact such structures have existed on Earth as long as life itself. This course basically provides a fundamental understanding of the relationships between physical properties or phenomena and materials dimensions. In the first three parts synthesis of various nanostructured materials are dealt in detail and last two units concentrate on the characterizations technique and the possible applications. Also a thorough review on the recently published articles will be done in order to have an up-to-date knowledge on the synthesis and characterization of nanostructured materials.

Contenidos:

- 1 Introduction and Zero dimensional nanostructures.
 - 1.1 Introduction.
 - 1.2 Emergence of nanotechnology.
 - 1.3 Physical chemistry of solid surfaces – surface energy – chemical potential as function of surface curvature – electrostatic stabilization- steric stabilization.
 - 1.4 Zero dimension nanostructures – Homogeneous Nucleation.
 - 1.5 Synthesis of metallic, semiconductor and oxide nanoparticles, vapor phase segregation.
 - 1.6 Heterogeneous nucleation –fundamentals and synthesis- kinetically confined synthesis, epitaxial core shell nanoparticles.

- 2 One-dimensional nanostructures.

- 2.1 One dimensional: Spontaneous growth, evaporation, vapor, stress induced.
- 2.2 Template based synthesis.
- 2.3 Electrochemical – electrophoretic – template filling – electrospinning.
- 2.4 Lithography.

- 3. Two dimensional nanostructures.
 - 3.1 Two dimensional – fundamentals of film growth.
 - 3.2 Vacuum science : Physical vapor deposition, Chemical vapor deposition.
 - 3.3 Atomic layer deposition.
 - 3.4 Super lattices.
 - 3.5 Self assembly.
 - 3.6 Electrochemical deposition.
 - 3.7 Sol-Gel.

- 4 Special nanomaterials and Properties of nanostructured materials.
 - 4.1 Carbon and fullerene nanotubes.
 - 4.2 Nanoclusters.
 - 4.3 Quantum Wells.
 - 4.4 Quantum wire and quantum dot structures.
 - 4.5 Structural characterization: XRD, SAXS, SEM, TEM y SPM.
 - 4.6 Chemical characterization.
 - 4.7 Physical properties of nanomaterials – optical, mechanical, electrical.

- 5 Application and Recent Advances in Nanostructured materials.
 - 5.1 Molecular electronics and nanoelectronics.
 - 5.2 Nanobots.
 - 5.3 Biological applications.
 - 5.4 Bandgap engineered quantum devices.
 - 5.5 Review of selected and latest articles published on the synthesis of nanostructured materials in peer reviewed international journals.

Books for study and reference

- 1. Introduction to Nanoscale Science and Technology, by Massimiliano Di Ventra (Editor), Stephane Evoy (Editor), James R. Heflin Jr. (Editor) – Springer (2004).
- 2. Nanostructures and Nanomaterials – Synthesis, properties and applications by Guozhong Cao, Imperial college press, London and distributed by World Scientific Publishing Co. Pte Ltd. (2004).
- 3. Introduction to Nanotechnology by Charles P. Poole, Jr. and Frank J. Owens, A John Wiley & Sons, Inc., (2003).