

# Nanotechnology

## 1 - Introduction to Nanotechnology.

- What is it?
- Size dependent properties.
- Surface effects: Surface energies and surface tensions. Surface reactivity and catalysis.
- Quantum effects: Tunneling, quantum confinement...

## 2 - Nanomaterials.

- Carbon nanotubes. Graphene.
- Nanoparticles.
- Colloids.
- Porous materials.

## 3 - Characterization techniques.

- IR, Raman, UV-VIS, Fluorescence, Confocal, DRX, XPS, Synchrotron.
- SEM, TEM, EDX.
- Tunnel effect techniques, AFM and related techniques.

## 4 - Reactivity of surfaces.

- Gas –solid reactions.
- Adsorption. Coverage. Calorimetry.
- Infrared Spectroscopy with probe molecules and HREELS.
- Sensors and catalysis.
- Surface reconstruction.

## 5 - Fabrication and preparation.

- Top-down and bottom-up.
- Lithographies: Optical (UV, DUV), e-beam litho, AFM based litho, Nanoimprint.
- Growth of films.

## 6 - Organic Optoelectronic Nanostructures.

- Organic PV.
- Molecular FET.

## 7 - Nanoelectronics.

- Confinement; Density of states.
- MOS revisited and scaling down
- UTB and FINFET
- Quantum conductance
- Resonant Tunneling and devices.
- High performance lasers

### **Evaluation:**

Written exam + Work-term reports on specific topics

Partial exam (EP) (35%) + Final Exam (EF) (35%) + Presentation of the report (PT) (30%)

### **Bibliography**

- "Introduction to Surface Chemistry and Catalysis" Gabor A. Somorjai  
Wiley-Interscience (1994) ISBN: 978-0471031925

- "Nanoscale science and technology " Ed: Robert Kelsall, Ian Hamley, Mark Geoghegan.  
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