

Nano-pores and membranes technologies

PAX9NCAH

Semester 9

Contents (Course in English)

Goal: From the sequencing and electronic analysis of single molecules, to waste water treatment, desalination, or osmotic energy harvesting, , nanopores and membranes technologies are a rapidly growing area of nanosciences with increasing applications in the fields of sustainable energy, environment, and nanobiotechnologies. The aim of the course is to provide the theoretical concepts governing the transport of fluids, ions and molecules in nanochannels and confined spaces. It will highlight the new properties and functionalities which arise from the interplay of surface interactions in solutions, flow and transport.

Content:

1. A general overview of nanopores and membrane technologies.
2. The basics of surface transport in fluids
 - . Flow and diffusion at a nano-scale
 - . Ions and molecule surface interactions in fluids
3. Coupled transport at surfaces and in nano-channels.
 - Electro-osmosis, diffusio-osmosis and beyond
 - Weak out-of-equilibrium limit and Onsager relations
 - From nano properties to macroscopic efficiency
 - Example of application: energy harvesting/conversion
4. Non-linear and rectification effects.
 - Nano-fluidic diodes, osmotic diode, and transistor.
5. Nano-pores for single molecules transport and detection
6. Membranes for fuel cells.

Prerequisite

Aspired expertise

Bibliography