CH-461

Nanofluidics

Kavokine Nikita

Cursus	Sem.	Type
Chemistry and Chemical Engineering		Obl.
Chimiste	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

This course introduces the modern theoretical tools that underpin the understanding of solid-liquid interfaces and fluid flows through nanometer-scale openings.

Content

The few nanometers where a solid ends and a liquid begins determine the large-scale behavior of many industrially-relevant systems, such as filtration membranes, electrochemical cells and supercapacitors. Nanofluidics is also a frontier for fundamental research, where the continuum of fluid dynamics meets the atomic and even the quantum nature of matter. This course introduces the modern theoretical tools that underpin the understanding of solid-liquid interfaces and fluid flows through nanometer-scale openings. In the first part, we will review the foundations of electrolyte theory and show how the interplay of the various electrostatic lengthscales can be used to tune nanofluidic transport. In the second part, will explore the limits of continuum theory and introduce some of the tools that can tackle sub-continuum, non-linear and quantum effects. The overall aim of the course is to give students an intuition for the solid-liquid systems that they may encounter across various areas of chemistry and physics.

Learning Prerequisites

Required courses

- An introductury course in equilibrium statistical mechanics.
- An introductory course in non-equilibrium statistical mechanics or transport phenomena.

Teaching methods

Lectures + exercise sessions.

Expected student activities

Assimilation of lecture material from one week to the next.

Assessment methods

Written exam at the end of the semester.

Supervision

Office hours	Yes
Assistant.e.s	Yes
Forum	Yes

Resources

Bibliography

1. Bocquet, L. & Charlaix, E. Nanofluidics, from bulk to interfaces. *Chemical Society Reviews* **39**, 1073-1095 (2010).
2. Kavokine, N., Netz, R. R. & Bocquet, L. Fluids at the Nanoscale: From Continuum to Subcontinuum Transport. *Annual Review of Fluid Mechanics* **53**, 377-410 (2021).

Notes/Handbook

Lecture notes will be provided.

Moodle Link

- https://go.epfl.ch/CH-461