Surfaces and Interfaces

Programme course

6 credits

Ytor och gränsskikt

TFYA47

Valid from: 2017 Spring semester

Determined by
Board of Studies for Chemistry, Biology and Biotechnology

Date determined
2017-01-25

Main field of study
Engineering Biology, Applied Physics, Physics

Course level
Second cycle

Advancement level
A1X

Course offered for
- Biomedical Engineering, M Sc in Engineering
- Engineering Biology, M Sc in Engineering
- Chemical Biology

Entry requirements
Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites
Basic knowledge of calculus in many variables, probability and statistics, classical physics, general chemistry, physical chemistry and quantum mechanics.

Intended learning outcomes

The course gives a general introduction to surfaces; their structure and physical-chemical properties, and interfaces between solids and organic materials or liquids. This includes hard surfaces (metals, dielectrics), soft matter surfaces (polymers and molecular films), free liquid surfaces and their interfaces, and colloidal systems. The course introduces analytical techniques for studies of surfaces, interfaces and thin films. After the course the student should be able to:

- Understand and describe properties of free liquid surfaces, such as surface tension, capillarity, wetting and spreading.
- Understand and describe electrical phenomena at surfaces, such as surface charge, surface potential, the electrical double layer, and basic electrochemical concepts.
- Describe the phase behaviour and aggregation of amphiphiles in solution and at interfaces.
- Desribe intermolecular forces, forces acting between molecules and surfaces, and surface forces.
- Describe common crystal structures of solid materials and understand the arrangement of atoms in surfaces made from such crystals.
- Describe the mechanisms that control the formation of overlayer structures on single crystal surfaces and classify such overlayer structures.
- Describe the shape and properties of common adsorption isoterms, and apply them for extraction of termodynamic or physicochemical data.
- Desribe the function and principles for common methods and instruments for surface and thin film analysis, as well as explain and interpret the information which can be obtained from these techniques.
- Desribe methods for the preparation and characterization of thin organic films on surfaces, in particular self-assembled monolayers.

Course content

Surface phases, surface energy, surface tension, surface excess. Free liquid surfaces, capillarity, Laplace' and Kelvin's equations. Wetting, contact angles, Young's equation. Surface charge, electrical double layer, Zeta potential. Amphiphilic aggregation and phase behaviour. Adsorption to liquid interfaces, Gibb's isotherm. Forces between molecules and between molecular systems and surfaces. Colloids and colloidal stability. The structure and properties of molecular films; preparation strategies, thermodynamically and kinetically controlled processes, surface modification, self-assembled monolayers.
Hard materials and surfaces, the structure of surfaces, the surface chemical bond, physisorption, chemisorption. Adsorption, adsorption kinetics and isotherms, surface reactions. Analytical methods for surface and interfacial analysis.

Teaching and working methods

The material is presented in lectures, as well as classroom and laboratory exercises.

Examination

LAB1	Laboratory course	1.5 credits	U, G
TEN2	Written examination	4.5 credits	U, 3, 4, 5

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

Supplementary courses: Surface science, Biosensor technology, Microsystems and Nanobiology, Biomedical materials.

Department

Institutionen för fysik, kemi och biologi

Director of Studies or equivalent

Magnus Boman

Examiner

Thomas Ederth

Course website and other links

https://www.ifm.liu.se/edu/coursescms/tfya47/

Education components

Preliminary scheduled hours: 48 h
Recommended self-study hours: 112 h

Course literature

Attard & Barnes, "Surfaces", Oxford University Press 1998. Barnes & Gentle, "Interfacial science", 2nd ed., Oxford University Press 2011.

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.