IM2667 Physics and Chemistry of Surfaces 7.5 credits

Ytors fysik och kemi

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for IM2667 valid from Autumn 2014

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Physics

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

Materials and their properties play a key role in todays society and technology; electronic devices and machines, catalytic reformation of chemicals, corrosion inhibition and protection, energy conversion, nanotechnology, construction materials. In many of those areas surface or interface effects are more or less important. In particular in nanotechnology it is often only the surface that is left.

After the course the students should be able to:

1) Analyze data from the methods presented in the course and calculate binding energies, charge transfer, electrical and optical properties, chemical composition and atomic structure. The analysis is not intended to include advanced computer based modeling.
2) Explain and judge relevant information from published research papers in surface science.
3) Select/suggest the proper set of experimental methods to determine the electronic and atomic structure, chemical composition and chemical bond strength for a given surface/interface system.
4) Describe the basic principles, surface specificity, advantages and limitations of the spectroscopic and microscopic methods presented in the course.
5) Judge the importance of surface effects on some technological areas, based on a physical description of those systems.
6) Describe and estimate how lattice structure and chemical bond influences on interface structure and surface reactions.
7) Describe the physical and chemical difference between a surface and the bulk of a material and how this depends on the type of bond in the material.

Course contents

The course will through a selected set of examples introduce and motivate a need for a detailed physical and chemical description of surfaces on the atomic/molecular level. This includes basic surface phenomena such as adsorption, desorption, chemical bonds and chemical reactions, thin film growth and their dependence on atomic and electronic surface structure, temperature, pressure and environment.
A set of experimental surface/interface preparation and analysis methods for determination of electronic and atomic structure will be presented and described, with the aim to provide the student with a “tool-box”. This box includes advanced electron and X-ray spectroscopy, electron spectroscopy, surface diffraction, synchrotron radiation and atomically resolved microscopy.
The course encompasses lectures, mini-conferences with student presentations, lab-work and a visit at the Swedish National Synchrotron Radiation Laboratory MAXLAB

Specific prerequisites

Solid State Physics

Course literature

“Lectures in Surface Science, with examples and solutions” M. Göthelid
“Introduction to Surface, interfaces and thin films”, H. Lüth, Springer Verlag

Selected overview papers on specific topics (indicated at each lecture and handed out in the beginning of the course)

Examination

- LAB1 - Lab Work, 1.5 credits, grading scale: P, F
- TEN1 - Examination, 6.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH’s coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Lab-work (1.5p)

The course is examined by a home-exam that is handed out at the first lecture. It contains problems from all parts of the course. Each problem is “multi-leveled” where each level requires different levels of understanding/problem solving abilities.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.