



LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Funktionella material **Functional Materials**

KASF10, 7,5 credits, G2 (First Cycle)

Valid for: 2023/24

Faculty: Faculty of Engineering, LTH

Decided by: PLED B/K

Date of Decision: 2023-04-18

General Information

Main field: Technology.

Compulsory for: N2

Language of instruction: The course will be given in English

Aim

- to provide the student with an overview of inorganic and polymer materials of technical importance, as well as their applications, from an atomic and molecular perspective
- to give examples of applications of materials science in the field of nanotechnology through lectures and compulsory assignments
- to give the student insight into how to manufacture functional materials, i.e. materials, or combination of materials which are designed on the atomic or nanolevel scale for a specific property.

Learning outcomes

Knowledge and understanding

For a passing grade the student must

- be able to describe the preparation and properties of metal alloys, ceramics and polymers of technical importance
- be able to explain how the micro- and nanostructure at different levels affects the properties of materials
- be able to describe the principles of important methods for the characterization of materials
- be able to give examples of methods for achieving nanostructuring of materials

Competences and skills

For a passing grade the student must

- be able to suggest simple tools, preparation and synthesis methods to achieve nanometer structures
- be able to apply basic knowledge of a broad range of properties of materials and use these to suggest new devices in physics, biomedicine, mechanics, nanoscale labs etc.

Contents

The course intends to give fundamental understanding of the properties of different materials, with special reference to the connection to atomic structure, molecular structure, preparation and function.

For inorganic materials we survey processes that alter the properties of ceramics, inorganic binders, metals and alloys, by modification of the atomic structure. Materials with a high degree of resistance towards high temperatures, corrosive environments and mechanical deformation are described. When it comes to polymers, emphasis is put on processes of polymerisation, properties in the solid state, melt and solution, as well as methods for producing specific shapes. We also review the application of functional polymers. Separate lectures and exercises for applications in nanotechnology will be given.

- Nanoapplications of polymers
- Common crystal structures for nanomaterial
- Catalysis on the nanoscale
- Nano- och microporous materials
- Piezoelectric nanotools
- Rat-on-a-chip
- Mechanical properties of chemical bonds
- Crystal structures (positions, directions, planes)
- Crystal defects of different dimensionality
- Dislocations and plastic deformation
- Point defects and diffusion
- Mechanical properties and fracture surfaces
- Hardening of metals and binary phase diagrams
- Important alloys and ceramics
- Classification, nomenclature and molecular weight of polymers
- Mechanisms and concepts in stepwise and chain polymerisation
- Industrial scale polymerisation
- Conformation and solubility of polymers
- Struktur-egenskapsrelationer hos amorfa och semikristallina polymerer Structure-property relations of amorphous and semi-crystalline polymers
- Mekaniska egenskaper hos polymerer, polymerblandningar och kompositer Mechanical properties of polymers, polymer mixtures and composites
- Tooling and rheology of polymers
- Applications of polymers: membranes and electronics

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)

Assessment: Written examination and exercises. Examination results define final result.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Admission

Admission requirements:

- Approved parts 0116 General and Inorganic Chemistry 6 credits and 0216 Laboratory Exercises 0 credits of the course KOKA30 General, Inorganic and Organic Chemistry

The number of participants is limited to: No

The course overlaps following course/s: KOO095

Reading list

- Fried, J. R. : Polymer Science & Technology, 3rd edition. Prentice Hall Ptr. , 2014, ISBN: 978-0-13-703955-5.
- Hand-outs.
- William D. Callister: Callister's Materials Science and Engineering, Global Edition. Wiley, 2020, ISBN: 978-1-119-45391-8.

Contact and other information

Course coordinator: Professor Reine Wallenberg, reine.wallenberg@chem.lu.se

Course coordinator: Professor Kimberly Thelander, kimberly.thelander@ftf.lth.se

Course homepage: <http://www.polymat.lth.se>

Further information: Teaching will be performed as lectures, exercises in the lecture hall and individual assignments (compulsory). PBL-exercises will be interleaved with lectures.