Science and Engineering of Soft Materials , 6.0 credits

Vetenskap och Teknik kring Mjuka Material , 6.0 hp

Third-cycle education course

6FITN75

Department of Science and Technology

Valid from: First half-year 2026

Approved by
The Board of PhD Studies

Approved
2025-11-03

Registration number

Entry requirements

Admitted to studies at postgraduate level

Learning outcomes

After finishing the course, the students should be able to:
Fundamentals on material properties and their functions: Explain the fundamental principles underlying the material properties of organic, carbon and metal nano materials, such as optical, electronic, ionic, redox-activity, catalytic and mechanical properties, and describe how they are connected the various device applications for bioelectronics, optoelectronics, thermoelectric, soft electronics and energy storage.
Design and synthesis: Understand structure-property relationships in polymers, organic (semi)conductors, carbon and inorganic nanomaterials, and explain how chemical design (e.g, monomer structure, synthesis method, functionalization) affects functional properties (e.g., optical, electronic, ionic, redox-activity, catalytic and mechanical)
Manufacturing Techniques: Summarise device fabrication techniques relevant to soft materials, especially solution-processing and printed electronics methods (such as ink formulation, screen/inkjet printing) and hybrid manufacturing approaches, and explain how these techniques influence scalability and device integration
Hybrid material systems: Explain how organic and inorganic components can be used together in hybrid systems and discuss advantages and disadvantages of such systems gather information about, present, and reflect on current research.
Sustainability and Society: Understand the environmental considerations of material design for electronics and energy applications. This includes applying principles of green chemistry and life cycle thinking in materials selection, synthesis, and processing. Describe various environmental assessment methods like Life-cycle assessment (LCA) for new materials or devices to ensure sustainable innovation.

Contents

Introduction to the application of soft materials (including organic (semi)conductors, functional polymers and nanomaterials) for electronics and energy devices. The topics cover:
• Organic Semiconductors charge transport & optoelectronic properties

• Multiscale modelling in organic electronics

• Organic semiconductor design & synthesis

• Organic Mixed Ionic-Electronic conductors

• Bioelectronics

• Bioengineering

• Organic energy materials (energy storage and thermoelectric)

• Organic devices for visible range optical engineering

• Nanomaterials (inorganic and carbon)

• Catalysis (hetero, electro & photocatalysis)

• Flexible & Stretchable electronics

• Printed & hybrid electronics

• Biomaterials & green chemistry

• Environmental assessment methods for materials science

Educational methods

Teaching will consist of lectures, and student-led seminars.

Examination

Attendance in-person at the lectures
Written examination 3 credits
Presentation Seminars 3 credits

Grading

Two-grade scale

Course literature

Lecture notes and relevant literature will be provided during the course
Articles
Compendiums

General information

Preliminary scheduled hours: 36 h

Recommended self-study hours: 120 h

15 topics – 2x 45 mins lecture