MICRO-514 **Flexible bioelectronics**

Lacour Stéphanie

Cursus	Sem.	Type
Biomedical technologies minor	H	Opt.
Data and Internet of Things minor	H	Opt.
Electrical and Electronical Engineering	MA1, MA3	Opt.
Life Sciences Engineering	MA1, MA3	Opt.
Microtechnics	MA1, MA3	Opt.
Neuroprosthetics minor	H	Opt.
Robotics	MA1, MA3	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

The course is an introduction to the emerging field of flexible (bio)electronics. It provides an overview of the materials and processes used to design and manufacture flexible circuits and sensors. Applications encompass flexible sensors, biointerfaces, human-machine interfaces and neuroprosthetic

Content

Because of the interdisciplinarity nature of the subject, the course content includes concepts from many disciplines in engineering (electrical, material sciences, mechancial, bio- and biomedical engineering). The three main components of the cours are: (1) key concepts in bioelectronics and biomechanics, (2) Materials and microfabrication, (3) Bioelectronic devices and applications. This course presents the main steps to follow to design flexible bioelectronic interfaces.

Detailed content:

1. Introduction: what is flexible (bio)electronics?
2. The nervous system
   a. Anatomy
   b. Fucntions
3. Materials and microfabrication for bioelectronics
   a. Substrates
   b. Electronic materials (inorganic & organic)
   c. Coatings and encapsulation
   d. Micro/nanofabrication on polymer substrates
      i. Vacuum based techniques
      ii. Printing
4. Thin-film electronic devices
   a. Thin-film transistors
   b. LEDs, OLEDs
   c. Sensors
   d. Performance under mechanical deformation
5. Microelectrode arrays for neural interfaces - neuroprosthetics
   a. Neural electrodes
   b. Electrochemical characterisation

Throughout the course, examples of current industrial and academic applications for mechanically compliant electronics will be given.

Keywords

Polymers, thin-films, devices, cleanroom technology, displays, neuroprosthetics, sensors.

Learning Prerequisites

Required courses

Biomaterials for SV students

Recommended courses

Sensors MICRO-330, Microfabrication MICRO-301, MICRO-331
Materials MSE-207, MSE-208

Important concepts to start the course

Basic concepts in electronics

Learning Outcomes

By the end of the course, the student must be able to:

- Select appropriately materials and associated manufacturing processes to design and manufacture an electronic device on flexible carriers
- Explain the operating principles of simple electronic devices (TFT, diodes, sensors for strain & strain, bioelectrodes)
- Distinguish the electrical and mechanical properties of devices materials and substrates
- Design a process flow to fabricate standard thin film electronic devices
- Interpret the main challenges in materials and process selection, and circuit design for deformable circuitry
- Integrate interdisciplinary notions from materials science, electronics, microfabrication and bioengineering to design flexible bioelectronic devices

Transversal skills

- Make an oral presentation.
- Summarize an article or a technical report.
- Write a scientific or technical report.

Teaching methods

- Lectures
- Team project (brief report and presentation)

Expected student activities

- attendance at lectures
- assess proposed litterature
- project presentation and report

Assessment methods

- oral (50%)
- project (50%)

Supervision

Office hours	No
Assistants	Yes
Forum	No

Resources

Bibliography

• Flexible Electronics: Materials and Applications (Electronic Materials: Science & Technology) by William S. Wong and Alberto Salleo (Paperback - Dec 8, 2010) Springer, 480pp Liens Moodle

• Materials Science and Engineering: An Introduction by William D. Callister (Author), David G. Rethwisch (Author) January 5, 2010, Wiley 992pp.

• J. H. Martin et al., in Principles of Neuroscience, edited by E. R. Kandel, J.H.Schwartz, and T. J. Jessel (Norwalk: Appleton and Lange, 2000), p. 340-352.

• Fundamentals of microfabrication 2nd or 3rd edition by M.J. Madou

Ressources en bibliothèque

• Materials Science and Engineering / Callister
• Fundamentals of microfabrication / Madou
• Principles of Neuroscience / Kandel
• Flexible Electronics/ Wong

Notes/Handbook

Lectures slides