MICRO-514 **Flexible bioelectronics**

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

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

Summary

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

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).
Detailed content:

1. *Introduction: what is flexible (bio)electronics?*
2. *Materials properties*
    1. *Substrates*
    2. *Active device materials (inorganic and organic materials)*
    3. *Coatings and encapsulation*
3. *Micro/nanofabrication on polymer substrates*
    1. *Vacuum based techniques*
    2. *Printing*
4. *Thin-film electronic devices*
    1. *Thin-film transistors*
    2. *LEDs, OLEDs*
    3. *Microsensors*
    4. *Performance under mechanical bending (flexibility)*
5. *Biosensors on foil*
    1. *Biocompatibility, sterilization*
    2. *Smart catheters*
6. *Microelectrode arrays for neural interfaces - neuroprosthetics*
    1. *In vitro platforms*
    2. *Implantable electrodes*

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

Recommended courses

Sensors
Microfabrication

Electronics I, II

Important concepts to start the course

Semiconductor devices
microfabrication

Learning Outcomes

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

- Explain the operating principles of thin film transistors
- Predict mechanical and electro-mechanical behavior of thin films under mechanical loading
- Derive simple process flow
- Estimate typical failure strain in thin fim devices
- Advise on materials to design and fabricate 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
Seminar(s) given by external speaker(s)

Expected student activities

attendance at lecturesassess propopsed litteratureproject 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
- Flexible Electronics/ Wong
- Principles of Neuroscience / Kandel
- Fundamentals of microfabrication / Madou

Notes/Handbook

Lectures slides