MICRO-373

Advanced microfabrication practicals

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Cursus	Sem.	Type
Microtechnics	BA6	Opt.

Language of teaching	English
Credits	3
Withdrawal	Unauthorized
Session	Summer
Semester	Spring
Exam	During the semester
Workload	90h
Weeks	14
Hours	**3 weekly**
Project	3 weekly
Number of positions	**21**

It is not allowed to withdraw from this subject after the registration deadline.

Remark

Avant de vous inscrire, merci d'obtenir l'autorisation préalable auprès de votre section

Summary

This TP allows for in-depth training on advanced micro and nanofabrication methods in a clean-room environment for selected applications, gain deeper knowledge in MEMS/NEMS processes, work in a small group together with PhD students/postdocs during 14 weeks touching all aspects of a microprocess.

Content

This TP will be done in small groups. Each group chooses one topic. Currently we have 3 topics offered for spring 2025:
Topic 1: **Fabrication, testing and validation of an integrated photonic chip on silicon on insulator/silicon nitride** (can be ring resonators, Bragg gratings, directional couplers)
Weekly schedule:

1. Mask design in gds using python package (week 1)
2. Mask design in gds using python package (week 2)
3. E-beam run for waveguide patterning (week 3)
4. Etching of waveguides, profilometer (week 4)
5. SEM images of waveguides (week 5)
6. PECVD deposition of oxide (week 6)
7. Transmission testing in the lab (week 7)
8. Transmission testing in the lab (week 8)
9. Data analysis (week 9): Q-factor, reflectivity, transmission, etc
10. Modelling (week 10)
11. Writing of report (week 11)
12. Writing of report, short presentation (week 12-14)

Topic 2: The bimorph cantilever (design, fabrication, testing)
Weekly schedule:

1. Theory (week 1), including choice for etching method (KOH, plasma, etc..)
2. Mask design (week 2)
3. Photolithography 1 (week 3)
4. Cr Etch and characterization (week 4)
5. Photolithography 2 (week 5)
6. SiO2 plasma (week 6)

7. Under etching for release (week 7) + Intermediate report
8. Characterization (week 8)
9. Characterization 2 (week 9)
10. COMSOL simulations (week 10)
11. Writing of report (week 11)
12. Writing of report, short presentation (week 12)

Topic 3: Manufacturing a high resolution computer generated hologram (CGH)
Weekly Schedule:

1. Theory 2 photon polymerization & CGH desing
2. Mask design in gds using python package (week 1)
3. Mask design in gds using python package (week 2)
4. Trial run of a simple structure with Nanoscribe (week 3)
5. Trial run of design with Nanoscribe (week 4)
6. Phase contrast image of structure (week 5)
7. (week 6)
8. Transmission testing in the lab (week 7)
9. Transmission testing in the lab (week 8)
10. Data analysis (week 9):
11. (week 10)
12. Writing of report (week 11)
13. Writing of report, short presentation (week 12-14)

Keywords

integrated photonic circuits
MEMS / NEMS design
microfabrication / nanofabrication
photonic devices
micromechanical actuator and sensor
process engineering and design
characterization techniques

Learning Prerequisites

Required courses

• MICRO-331

Important concepts to start the course

• Previous knowledge of basics microfab and
• highly interested in microfab aspects

Learning Outcomes

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

• Establish a MEMS/integrated photonic circuit design and process flow
• Implement various methods in the correct order to manufacture a MEMS.
• Assess / Evaluate the outcome of own design approach using advanced characterization methods.

Transversal skills

• Set objectives and design an action plan to reach those objectives.

- Use a work methodology appropriate to the task.
- Negotiate effectively within the group.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Manage priorities.
- Access and evaluate appropriate sources of information.
- Summarize an article or a technical report.
- Make an oral presentation.

Teaching methods

This course is given in group of 3 or 4 students who work closely together with a PhD student to go through the entire run of a MEMS process. The teaching is thus based on hands-on training accompanied by literature/process flow study, design optimization and final characterization.

Expected student activities

Each student is attending in their group a weekly session with the PhD student to run through the process flow of the MEMS device, thereby builing up from initial design, simulation, fabrication and final testing. The course will be concluded by a short report and oral presentation.

Assessment methods

The work is assessed by three components:
- lab activities
- report
- oral presentation

Supervision

Office hours	No
Assistant.e.s	Yes
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

see documentations on MOODLE page

Notes/Handbook

on MOODLE

Moodle Link

- https://go.epfl.ch/MICRO-373