Microfabrication

CHEM-E5115

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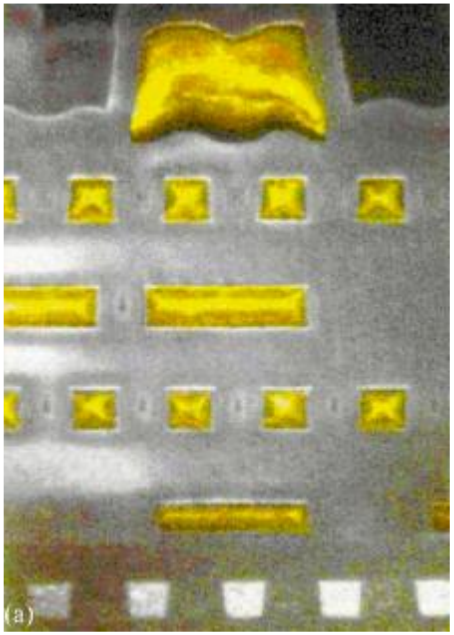
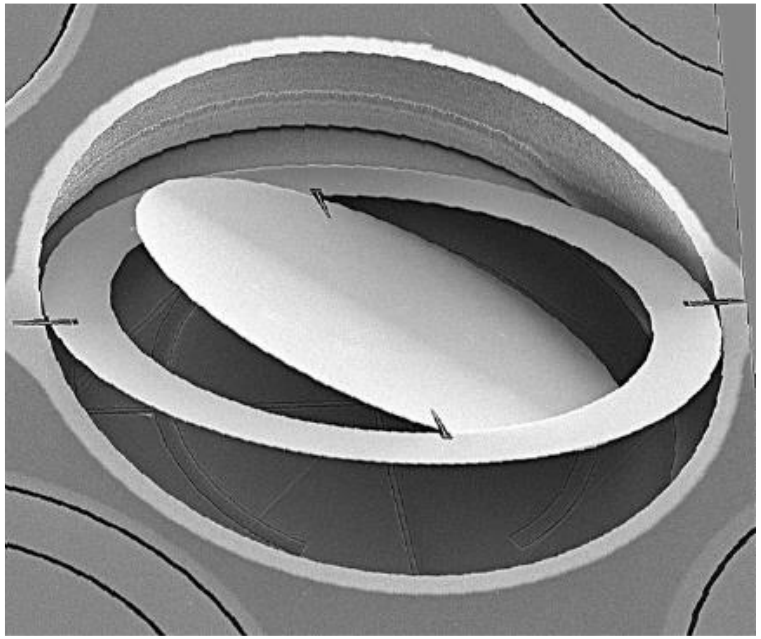
Goals

After the course you should be able to design simple microfabrication processes and analyze complex processes.

The devices look like these:



CMOS metallization



MOEMS mirror

You must understand:

Microscale dimensions

- -is 100 nm linewidth feasible ?
- -is 4 nm film thickness possible ?
- -is 100 nm/min high or low rate?
- -is 300 MPa high or low stress ?
- -is 20 $\mu\Omega$-cm low enough resistivity ?

Materials

- -silicon wafers
- -thin films of SiO_2, SiN_x, Al, W, Cu, Au, Pt, ……

Processing of materials at microscale:

- -patterning
- -doping
- -thin film deposition
- -bonding

Learning

Book

-Introduction to Microfabrication

-provides the facts

Lectures

-show how to think about the facts

-show how to think with the facts

-are no substitute for reading the book !

Exercises

-develop feeling for orders of magnitude

-check understanding of basic concepts

-get acquainted with fabrication processes

Lab demo: 2-3 hours in Micronova cleanroom

-hands-on microfabrication (lithography & etch)

The book

Introduction to Microfabrication, 2nd edition (John Wiley, 2010)
The course covers chapters 1-6, 9, 11-17, 20,21, 25-31, 35-38 (ca. 60% of the book).

First edition 2004 can also be used.

Available as e-book via Aalto library: http://lib.aalto.fi/en/

http://site.ebrary.com/lib/aalto/docDetail.action?docID=10419414

Printed book from amazon (40£ used/50£ new + mail)

Homework exercises

Published on Tuesdays at 12 noon in MyCourses

Return to MyCourses by following Sunday 10 pm (22.00)

pdf best format, MS Word also acceptable

Late return box will be provided, but 1 point reduced

Assistants will check and grade answers.

In Tuesday exercise session solutions are presented on board by the students (selected by the assistant from the best solutions)

On-the-spot exercises

Groups of 3-4 persons

Immediately after the lecture ➔ you have to read the related book chapters before the lecture !

Includes three phases:

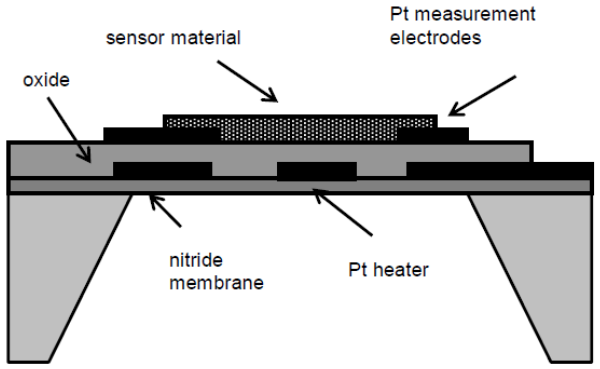
1) group work
2) evaluation the solution of another group
3) Wrap-up by teachers

Maximum 4 points, same for all group members. 26 points available. Absence cannot be compensated.

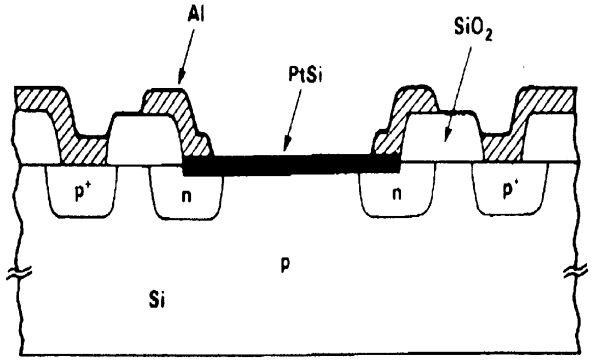
Examples of exam questions

- Compare optical lithography and electron beam lithography.

- Explain step-by-step how the micro hot plate shown on top right was fabricated.



- Explain step-by-step how the photodiode shown on the bottom right was fabricated.



- The sensor is a wet etched silicon membrane device (20 µm membrane thickness). Membrane size is 1 mm*1 mm. How many good chips do you get from a 100 mm wafer? The cost of wafer processing is taken as 2 €/cm^2 . How much does a single sensor cost if silicon chip cost is 30% of total sensor cost ?

- Chemical-mechanical polishing.

Exam cheat sheet

In the exam a cheat sheet will be used.

You can thus avoid memorizing facts and concentrate on concepts.

One A4 sheet (both sides), handwritten.

Must be returned with the exam paper.

Grading

Evaluation:	Points	Breakdown	Threshold	Hours
Exam	60	5 questions	40% = 24 p	3
Homeworks 1-3, 5-8	28	4 p/home	40% = 13 p	32
Lab homework #4	4	4 p/report	compulsory	8
Spot exercises 1-6	18	3 p/spot		6
Self-study: Introduction to Microfabrication				69
Lectures				17
Total	110			135

Related courses

FALL TERM 2019

- CHEM-L2200 Advanced microfabrication
- CHEM-E5225 Electron Microscopy
- ELEC-E3140 - Semiconductor Physics
- PHYS-E0424 Nanophysics
- ELEC-E8713 Materials and microsystems integration

SPRING TERM 2020

- CHEM-E4105 - Nanochemistry and Nanoengineering
- CHEM-E5125 - Thin Film Technology
- CHEM-E8135 - Microfluidics and BioMEMS
- ELEC-E3220 - Semiconductor Devices
- ELEC-E8711 - Materials Compatibility
- ELEC-E3210 – Optoelectronics

Lab exercise

Enrollment opens on March 12th

Groups run from March 12th for 2 weeks

Lab report deadline March 31st

Lab report is one of the homeworks, graded similarly

If you do not turn up in lab demo group, you will receive minus points, so make sure that you enroll into a group that suits your timetable.