Microfabrication 2024

CHEM-E5115

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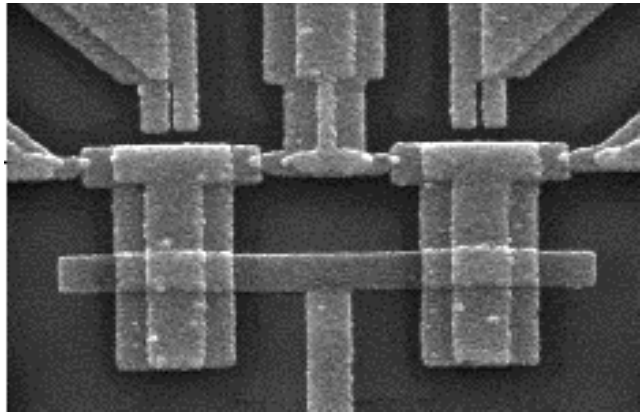
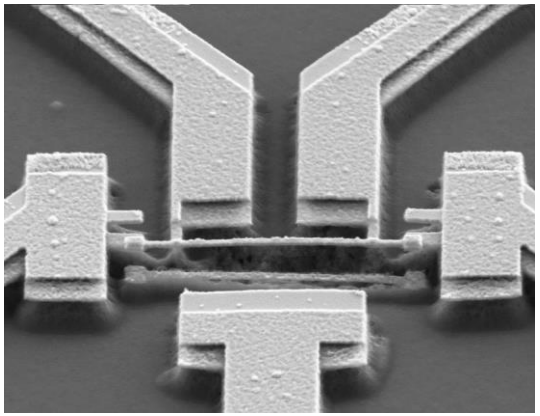
Goals

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

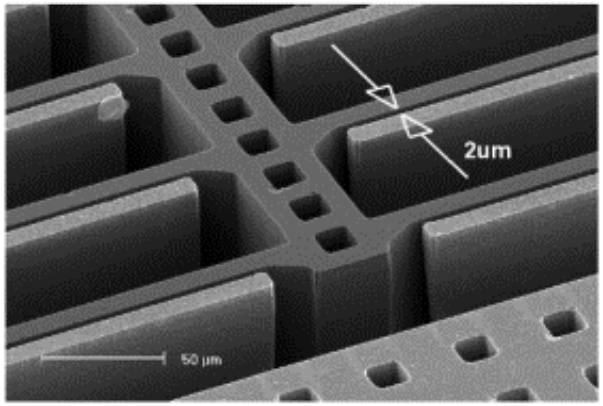
The devices look like these:



CMOS transistors



Nanobridge



MEMS accelerometer

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

-are no substitute for reading the book !

Spot exercises

-simple group work

-check understanding of basic concepts

Home exercises

-develop feeling for orders of magnitude

-practice fabrication processes on paper

Lab demo: 3 hours in Micronova cleanroom

-hands-on microfabrication (lithography & etch)

-electrical measurements outside cleanroom, too

Pre-reading

The slides are available beforehand (we aim for Friday, but Monday morning latest).

We expect that you have familiarized yourself with them, because the pace of lectures is based on assumption that students know the stuff.

Use lectures to ask questions of topics that you did not understand during self-study.

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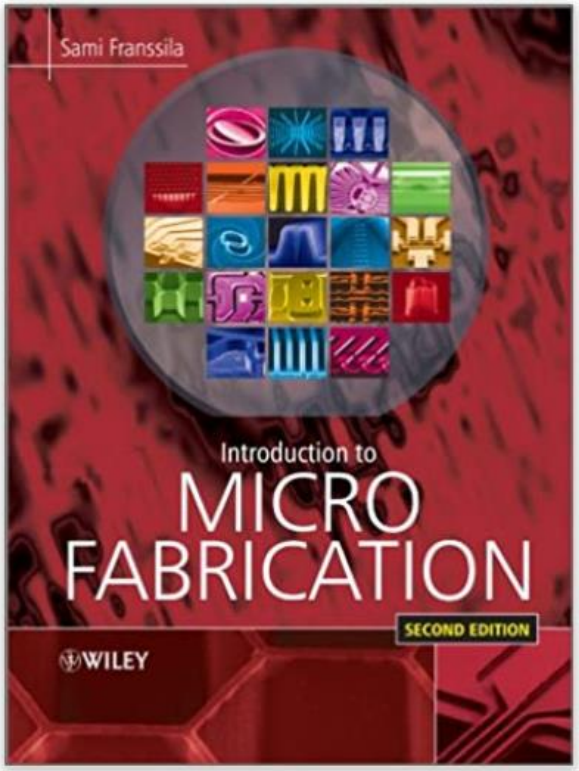


Introduction to Microfabrication

2010

by Sami Franssila (Author)

★★★★☆ 11 ratings

See all formats and editions

Kindle Edition	**Hardcover**
£53.19	**£61.65**
Read with Our **Free App**	5 Used from £30.29 8 New from £55.85

27.2.2023

The book

Introduction to Microfabrication, 2nd edition (John Wiley, 2010). First edition 2004 can also be used.

The course covers chapters 1-6, 9, 11-17, 20,21, 25-31, 35-38 (ca. 60% of the book).

Available as e-book via Aalto library: http://site.ebrary.com/lib/aalto/docDetail.action?docID=10419414

Other good readings:

Short notes on semiconductor technology: http://www.semi1source.com/notes/

Homework exercises

Individual. If you submit pieces of text written by somebody else (such as AI or your buddy) as your work, disciplinary action will be taken.

Published on Tuesdays at 12 noon in MyCourses.
Return to MyCourses by following Sunday 10 pm (22.00).
Late return box will be provided, but points halved !

pdf preferred, pptx also acceptable

Assistants will check and grade answers.

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

On-the-spot exercises

Groupwork. Small groups, 2-4 persons.

Includes three phases:

1) group work
2) two groups cross-check each others solution
3) wrap-up by teachers

Maximum 1 points, same for all group members.
7 spots ➔ 7 points available.
Absence cannot be compensated.

Cleanroom lab demo

Enrollment opens on March 5th, 12 noon

Groups run from March 12th to March 29th 2024
Lab report deadline April 7th (same for everybody)
Lab report feedback session April 9th

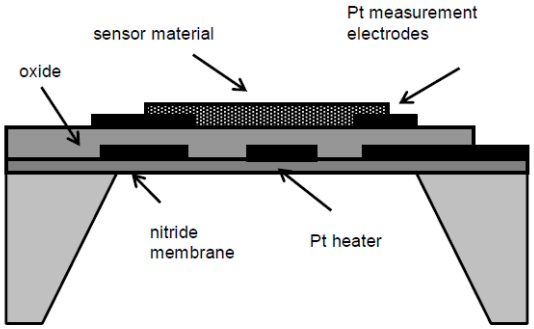
Lab report is a compulsory part of the course.

Lab report is personal but of course the whole group is using the same data.

Examples of exam questions

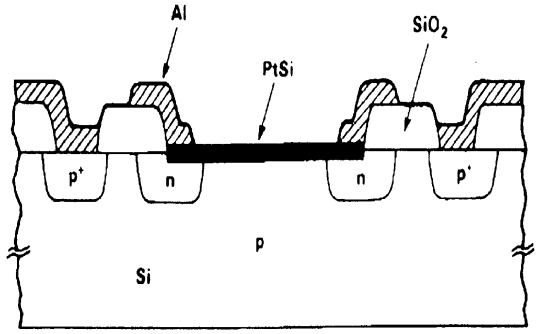
- Compare optical lithography and electron beam lithography.

- 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.

Grading

Grading:	exam **(minimum 40% must)**	60
	homeworks, 8*4 points **(minimum 40% must)**	32
	lab report, 9 points **(must pass)**	9
	spot exercises 7*1 points	7
	webropol feedback	2
	Total:	110
Graded according to 100 points. Therefore no compensation for missed elements.		

Related courses

FALL TERM 2024

- CHEM-E5150 Surfaces and films
- ELEC-E3140 Semiconductor Physics
- ELEC-E8713 Materials and microsystems integration
- ELEC-E8715 Design and analysis of MEMS
- ELEC-E3280 Micronova lab course

SPRING TERM 2025

- CHEM-E4105 Nanochemistry and Nanoengineering
- CHEM-E8135 Microfluidics and BioMEMS
- ELEC-E3220 Semiconductor Devices
- ELEC-E3210 Optoelectronics