Microfabrication CHEM-E5115

Home exam May 25th, 2020, 9.00-12.30

Answer 5 out of 6 questions. All questions are worth 6 points.

If you answer all 6, the best one will be dropped out.

Make sure your answers are coherent and consistent: a collection of factsisnot an answer.

You have to argue for your choices: there is usually more than one way of doing things, and therefore you have to give reasons for doing things your way.

Draw figures and graphs when appropriate.

When asked to explain a fabrication process step-by-step, it means that you have to list the MAIN steps in the very order they are made. Main steps: LITHOGRAPHY, ETCHING, CLEANING, DIFFUSION/IMPLANTATION, ANNEALING, OXIDATION, EPITAXY, THIN FILM DEPOSITION, CMP, BONDING.

Note that some features in the drawings are because of drawing software only and do not represent actual microfabrication profiles.

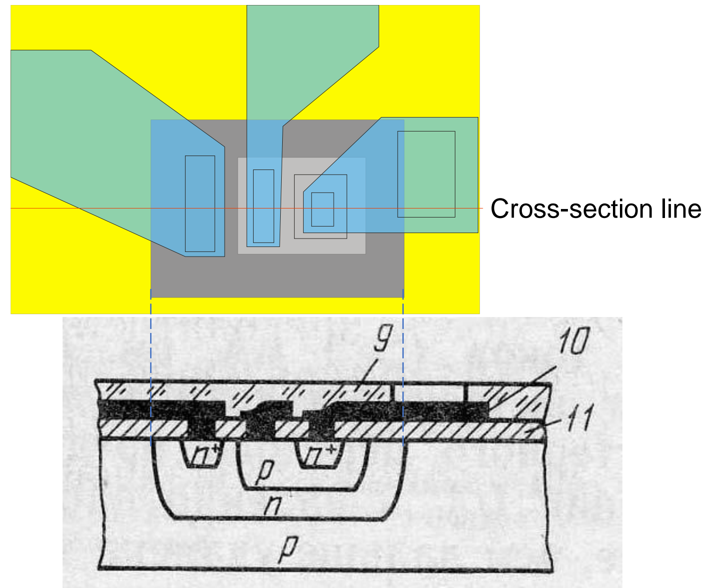
The exam is strictly personal, and you cannot submit anything that is not produced by you yourself. For instance, text copy-pasted from internet will mean disqualification immediately.

The exam is 3h30 min because you have to provide a single document. For example, if you hand draw, you have to scan or photograph the drawings, and implement them into your main document.

Preferred final document format is pdf. MS word is also acceptable.

Documents without student name and student id number on the front page will not be graded.

1. Explain step-by-step the process flow to fabricate the silicon bipolar transistor shown below. Additionally, identify all materials used. Give your estimates of lithographic linewidths and diffusion depths (6 p).
Note: Layer 10 is metallization.
Optical contact lithography is in use.



2.Shortly explain the following concepts and describe fabrication (main steps, methods, typical values) for the following: 2 point each.

a) LDD
b) STI
c) salicide

3a. Optical 1X contact/proximity lithography, 3 p.

3b. Optical 1X contact/proximity lithography issues in MEMS, 3 p.

4. Shortly explain the main similarities and the main differencies between the two concepts. 1 point each.

a) Reactive Ion Etching (RIE) and Ion Beam Etching (IBE)

b) thermal oxide and CVD oxide

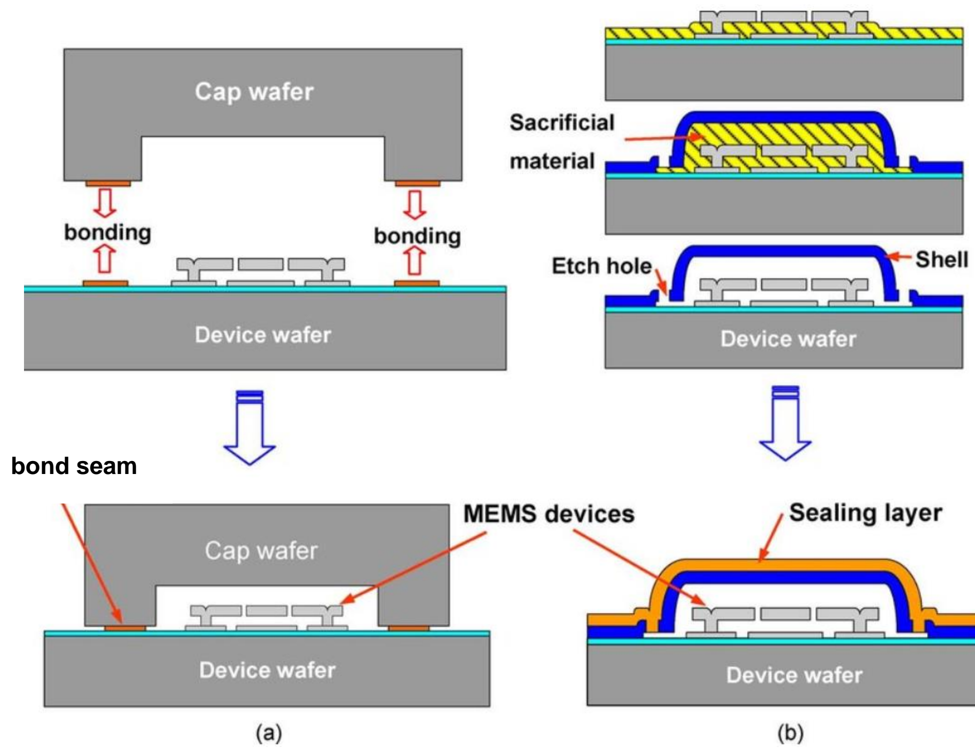
c) ion implantation and thermal diffusion

d) etch mask and photomask

e) epitaxial silicon and polysilicon

f) plasma etching and dry etching

5. MEMS zero-level packaging. Explain the main ideas of the encapsulation processes (a) and (b). Discuss strengths and weaknesses and compare the two. 6 points.



6. Explain step-by-step fabrication of this device. Identify materials, tell about their deposition processes, discuss etch selectivities etc. Add your estimates of all dimensions.