UNIVERSITY OF OSLO

FACULTY OF MATHEMATICS AND NATURAL SCIENCES

Guide for this exam:

Exam in: FYS4260 Microsystems and Electronic Packaging & Interconnection Technologies

Day of exam: Friday, May 29th, 2009

Exam hours: 14:30 – 17:30 (3 hours)

This examination paper consists of 4 page(s).

Appendices: No appendices

Permitted materials: None except the general allowed aids as for instance approved electronic calculators. For instance, tables and programmed data in calculators not allowed.

Make sure that your copy of this examination paper

is complete before answering.

Miscellaneous:

Course responsible Per Øhlckers will be present at University of Oslo on exam day and can be reached on cell phone 9590 3989. / Kursansvarlig Per Øhlckers vil være tilstede på Universitetet i Oslo på eksamensdagen og kan nåes på mobiltelefon 9590 3989.

The test questions are given in Norwegian and English, and can be answered in either Norwegian or English. Use maximum 1 page for each question; that is for the sum of both the a) and the b) answers / Hvert spørsmål gis både med norsk og engelsk tekst. Besvarelsen kan gis valgfritt på norsk eller engelsk. Bruk maksimum 1 side på hver oppgave, dvs. summert for både a) og b) besvarelsen.

Question 1: Electronic products for different application areas.

a) Military electronics is an important application area for electronics. Describe the most important general requirements for the electronics for this application area. Describe at least 3 to maximum 5 other application areas for electronics, and the most important requirements in the respective application areas.

b) Electronics specially made for military applications are increasingly replaced by electronics made for civilian applications. Describe the most important reasons why this is happening.

Suggested answer:

a) *Recommended answer: Subjective assessment: High reliability, long lifetime, environmental issues, etc., etc. Other application areas can for instance be: biomedical, automotive and consumer.*

b) *Recommended answer: Subjective answer: Keywords might be: High development costs, high product cost because of low volume production, slow innovation speed, etc. Electronics for civilian applications is now of such high quality that it can be used in military systems as submodules.*

Question 2: Printed wiring boards (Unassembled printed circuit boards)

a) Make a cross-section view of a four layer through plated printed wiring board, and describe the manufacturing process for such a printed wiring board by outlining a flow chart with supplemental text for each process step, including how the through plated via holes are made.

b) Describe 3 different laminate materials often used in printed wiring boards, and describe 2 advantages and 2 drawbacks for each of them.

Suggested answer:

a) *Recommended answer: See fig 5.7, page 5.14 and page 5.12-13.*

b) Recommended answer: See page 5.1-2.

Question 3: Thermal management

a) Explain some methods of simulation of the thermal behaviour of components. Point out strengths and weaknesses of these methods.

b) Calculate the increase of the junction temperature of an integrated circuit in a LLCC package with 3W heat dissipation. Thermal resistance from the circuit junction to case is R_{JC} =10 °C/W, and from case to ambient is RCA=5°C/W. Calculate also the resulting thermal resistance RJA from junction to ambient.

Suggested answer:

a) Recommended answer: See page 6.32.

b) Recommended answer: Fasit: Use the formula: DeltaT = P•R, as shown in Chapter 6.6.3 on page 6.24. The answers wiløl be: $R_{JA} = R_{JC} + R_{CA} = 10 + 5 = 15\,°C/W$ $\quad DeltaT = 3*15 = 45\,°C$

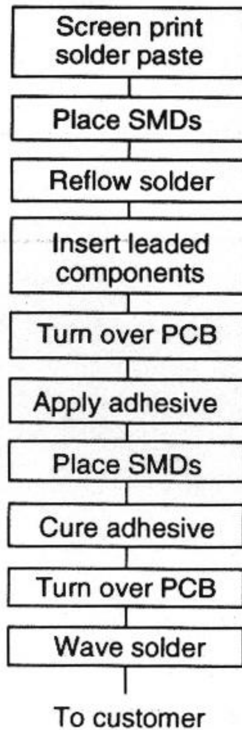
Question 4: Printed Circuit Boards (Assembled Printed Circuit Boards)

a) Explain a common used manufacturing technology for double sided printed circuit boards with surface mount devices (SMD) on both sides of the board and hole mounted devices on one side of the board. This is best done by outlining a flow chart with a supplemental text for each process step.

b) Explain the reflow soldering process for a printed circuit board. Describe two important ways to heat the board when doing reflow soldering. Explain also why cleaning of printed circuit boards with Freon(fluorocarbon) liquids after reflow or wave soldering where phased out, and how this issue is typically handled today.

Suggested answer:

a) *Recommended answer: Se page 7.40.*



b) *Recommended answer: Se page 7.13.*

Question 5: Micromachined Devices/Microsystems MultiProject Wafer (MPW) foundry services

a) SensoNor Technologies of Horten, Norway is offering microsystems MPW foundry services based upon their Bulk Micromachining technology, called MultiMEMS MPW. A cross-sectioned view of the process is shown in Figure 5.1 below.

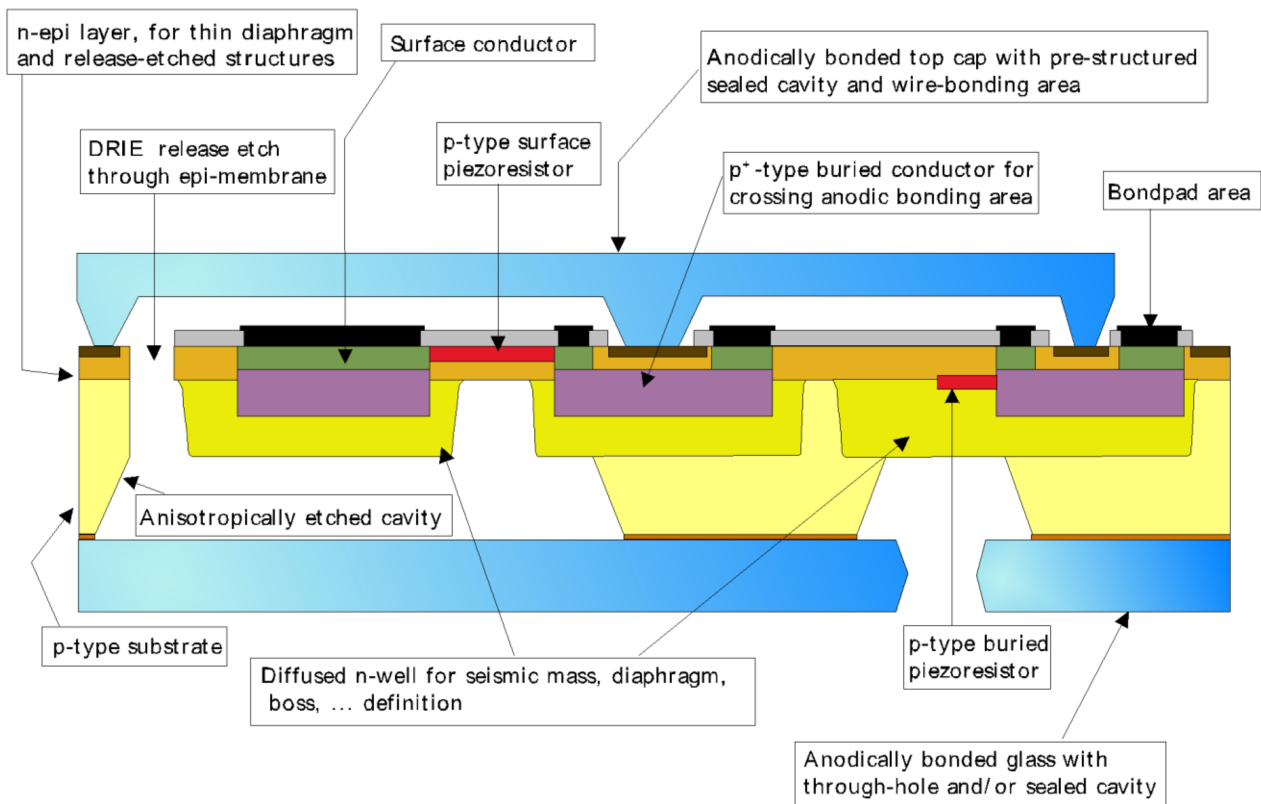


Figure 5.1: Cross section view of the MultiMEMS MPW process technology from SensoNor Technologies/Figur 5.1: Tverrsnittbilde av MultiMEMS MPW prosess teknologi fra SensoNor Technologies.

Visualise some of the basic features of the MultiMEMS MPW process by explaining how a 1-axis accelerometer can be designed and manufactured in this process. This is best done by combining text and graphic presentation. Explain how we can adjust the full scale acceleration range.

b) Describe how the anisotropic wet etching process is included in the MultiMEMS' MPW process to make backside etch geometries with precise sideways and depth control of dimensions. Explain specifically the principles used in the selective etch process to achieve precise etch pit depth control. This is best done by combining text and graphic presentation.

Suggested answer:

a) *Recommended answer: See MultiMEMS presentation on the course web site:* 8-MPart2(MPW_Process_Description I).ppt

b) *Recommended answer: See the ppt-presentation on on the course web site:* Chapter 9.

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