Second Semester Examination
2022/2023 Academic Session

Julai/Ogos 2023

# EPE 442 – Advanced Semiconductor Technology
## *(Teknologi Pembuatan Semi Konduktor Termaju)*

Duration: 3 hours
*(Masa: 3 jam)*

Please check that this examination paper consists of FIVE (5) pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi LIMA (5) muka surat yang bercetak sebelum anda memulakan peperiksaan ini].*

**Instructions :** Answer **ALL FIVE (5)** questions.

*[**Arahan :** Jawab **KESEMUA LIMA (5)** soalan.]*

…2/-

1. [a] In the semiconductor industry, there are many companies are interconnected to form a semiconductor ecosystem. These companies are responsible and specialize in designing, production, assembly, inspection and distribution. Explain what is Fabless, Foundry, and Outsourced Semiconductor Assembly Test (OSAT) companies, and how these companies are connected in making chips.

**(50 marks)**

[b] In Malaysia, companies in the semiconductor industry are mainly involved in OSAT and back-end-line (BEOL) manufacturing processes. Companies like Inari, UNISEM, and KESM are some of the publicly listed companies that are leaders in Malaysia. In 1995, Silterra Malaysia Sdn. Bhd was incorporated as part of the strategic plan for Malaysia to promote front-end-line (FEOL) semiconductor manufacturing. In 2022, Dagang NeXhange Bhd (Dnex) teamed up with Foxconn to acquire 100 percent stake in Silterra and announced to build the first 12-inch wafer fabrication facility in Malaysia as shown in Figure 1[b]. Based on this statement, explain the challenges faced by Malaysia to build our own Foundry ecosystem.


Figure 1[b]

**(50 marks)**

…3/-

2. [a] How do you turn sand to 9N purity (electronic-grade) wafer? You may use flow diagram to help illustrate the process.

**(40 marks)**

[b] How do you turn sand to <5N purity (solar grade) wafer? You may use flow diagram to help illustrate the process.

**(20 marks)**

[c] Figure 2[c] shows a basic structure of a MOSFET transistor. From an 8-In wafer, how do you fabricate the wafer until it becomes a MOSFET with a similar structure as shown in Figure 2[c]. Explain each process using a flow diagram.

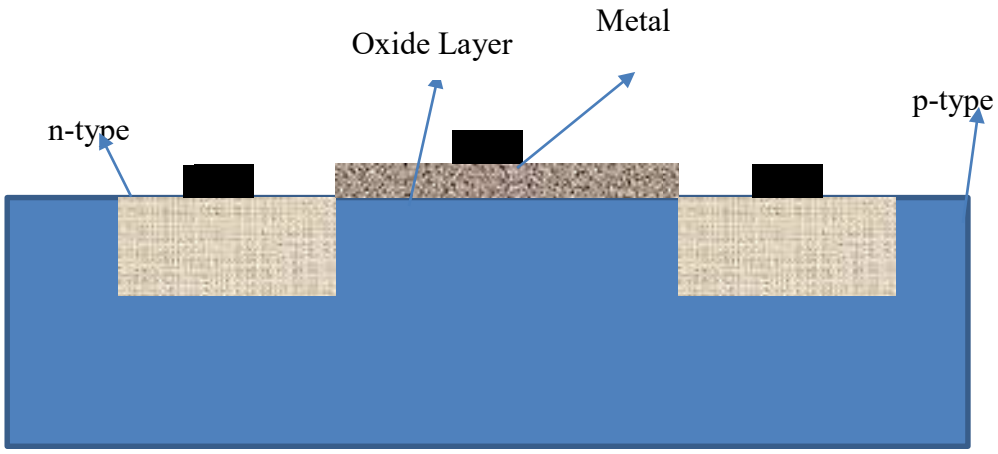


Figure 2[c]

**(40 marks)**

3. [a] The thin film deposition process involves depositing a thin film of an oxide material onto a substrate using oxidation techniques. Dry oxidation and wet oxidation are two commonly used techniques in the industry. Compare these two techniques by completing the information in Table 3[a]. (Please copy the table provided and complete it in your answer script.)

Table 3[a]

| Elements | Dry Oxidation | Wet Oxidation |
|---|---|---|
| Process Environment | | |
| Oxidizing Species | | |
| Oxidation Rates | | |
| Film Properties | | |
| Application | | |

**(50 marks)**

…4/-

[b] State TWO (2) doping methods utilized in semiconductor manufacturing that are employed to deliberately introduce impurities into a semiconductor material, such as silicon, in order to modify its electrical properties.

**(20 marks)**

[c] Provide THREE (3) essential requirements that must be fulfilled for Thin Film Deposition (TFD) to be successful.

**(30 marks)**

4. [a] Figure 4[a] depicted one of the process steps in Level 2 semiconductor manufacturing.

(i) Name the process depicted in Figure 4[a].

**(10 marks)**

(ii) Explain THREE (3) types of defects that can occur in that process and their corresponding sources of defects.

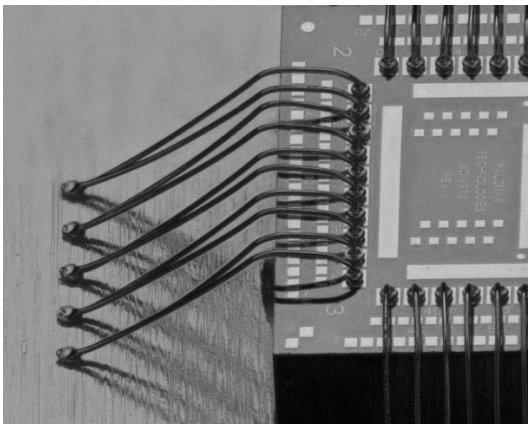

Figure 4[a]

**(60 marks)**

[b] After the encapsulation process, the packaged chips are subjected to thorough testing to assess their functionality and quality. Testing comprises electrical tests, functional tests, and potentially reliability tests, all aimed at confirming whether the chips meet the prescribed performance criteria. Explain THREE (3) reasons why conducting these tests are necessary.

**(30 marks)**

5. [a] Covid-19 pandemic has accelerated digitalization transformation all around the world. Even post-covid, remote learning and virtual conference is still prevalent compared to pre-covid. New technology implementations such as 5G network, AI, and EV form robust demand for chips. Suggest THREE (3) actions that could be taken by Malaysia to be a competitive nation and remaining competitive in the semiconductor industry.

**(30 marks)**

[b] Describe recent advances in flexible electronics. List the advantages of flexible circuits as compared to current rigid printed circuit board (PCB) technology.

**(40 marks)**

[c] Provide FOUR (4) factors that drive the recent advances in flexible electronics.

**(20 marks)**

[d] In a statement by Elon Musk, he tweets "We are now confident that the Neuralink device is ready for humans, so timing is a function of working through the FDA approval process." Explain how flexible electronic devices have enormous potential for use on and in the human body?

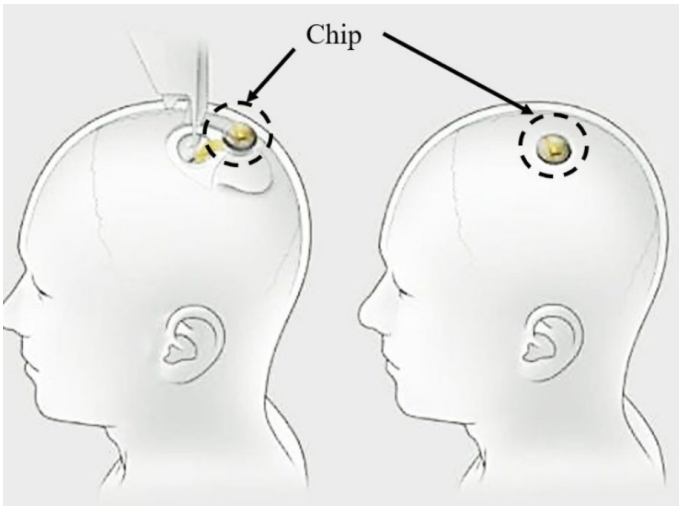


Figure 5[d]

**(10 marks)**

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