UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2007/2008

October/November 2007

EBB 323/3 - Semiconductor Fabrication Technology
[Teknologi Fabrikasi Semikonduktor]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains SIX printed pages before you begin the examination.
[Sila pastikan bahawa kertas peperiksaan ini mengandungi ENAM muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

This paper contains SEVEN questions.
[Kertas soalan ini mengandungi TUJUH soalan.]

Instructions: Answer any **FIVE** questions. If a candidate answers more than five questions, only the first five answers will be examined and awarded marks.
*[**Arahan:** Jawab **LIMA** soalan. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]*

Answer to any question must start on a new page.
[Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.]

You may answer a question either in Bahasa Malaysia or in English.
[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

1. [a] Briefly describe 3 applications of epitaxial layers.

Jelaskan secara ringkas kegunaan lapisan epitaksi.

(20 marks/*markah*)

[b] Explain 3 techniques to produce epitaxial layers.

Terangkan 3 teknik untuk menghasilkan lapisan epitaksi.

(30 marks/*markah*)

[c] Describe defects in epitaxial layers.

Jelaskan kecacatan dalam lapisan epitaksi.

(20 marks/*markah*)

[d] Describe 5 major contamination sources in semiconductor industries.

Huraikan 5 punca pencemaran utama dalam industri semikonduktor.

(30 marks/*markah*)

2. [a] What are the principle uses of SiO_2 layer in Si wafer devices?

Apakah kegunaan utama lapisan SiO_2 dalam peranti silikon?

(20 marks/*markah*)

[b] Briefly explain the thermal oxidation mechanisms of silicon.

Huraikan secara ringkas mekanisma pengoksidaan terma silikon.

(25 marks/*markah*)

[c] What are the factors that influence the oxidation rate of silicon?

Apakah faktor-faktor yang mempengaruhi kadar pengoksidaan silikon?

(30 marks/*markah*)

[d] With the help of a diagram, briefly describe the kinetics of oxidation process.

Dengan bantuan gambarajah, terangkan secara ringkas kinetik proses pengoksidaan.

(25 marks/*markah*)

3. [a] Describe

(i) diffusion process

(ii) ion implantation process

Huraikan

(i) proses resapan

(ii) proses penanaman ion

(40 marks/*markah*)

[b] Explain advantages and disadvantages of ion implantation process over diffusion process.

Jelaskan kelebihan dan kekurangan proses penanaman ion berbanding proses resapan.

(30 marks/*markah*)

[c] With the help of diagrams, briefly describe diffusion mechanisms.

Dengan bantuan gambarajah, jelaskan secara ringkas mekanisma proses resapan.

(30 marks/*markah*)

4. [a] Briefly describe a plasma etching process.

Secara ringkas huraikan proses punaran plasma.

(30 marks/*markah*)

[b] Explain the differences between a subtractive etching and additive liftoff methods.

Terangkan perbezaan di antara punaran penolakan (subtractive etching) dan kaedah "additive liftoff".

(40 marks/*markah*)

[c] Why selectivity of an etchant is important?

Mengapa kebolehpilihan (selectivity) bahan punaran amat penting?

(30 marks/*markah*)

5. [a] Kinetic theory of gas can be described by the following equation

$$\lambda = \frac{kT}{\sqrt{2}\pi d^2 P}$$

where, λ, d, k, T, and P are the average distance between collision of atom/molecule, diameter of atom/molecule, Boltzmann constant, temperature, and pressure respectively. Explain the physical meaning of this equation.

Teori kinetik gas boleh dihuraikan dengan persamaan berikut:

$$\lambda = \frac{kT}{\sqrt{2}\pi d^2 P}$$

di mana λ, d, k, T, dan P ialah masing-masing jarak purata di antara perlanggaran atom/molekul, diameter atom/molekul, pemalar Boltzmann, suhu, dan tekanan. Terangkan maksud fizikal persamaan tersebut.

(40 marks/*markah*)

[b] What are the technological challenges of using copper interconnects?

Apakah cabaran-cabaran yang dihadapi oleh penyambungan dengan kuprum?

(50 marks/*markah*)

[c] Define the following terms: (i) isotropic etching and anisotropic etching.

Takrifkan istilah berikut: (i) punaran isotropik dan punaran tak isotropik.

(10 marks/*markah*)

6. [a] Where are the potential applications of high and low dielectric constant thin film in ULSI?

Dimanakah potensi kegunaan filem nipis berpemalar dielektrik tinggi dan rendah di ULSI?

(40 marks/*markah*)

[b] What are the driving forces on electronic packaging technology?

Apakah pendorong dalam teknologi pembungkusan elektronik?

(30 marks/*markah*)

[c] Briefly explain the following terms: (i) Functional yield and (ii) Parametric yield.

Secara ringkas terangkan istilah berikut: (i) "Functional yield" dan (ii) "Parametric yield".

(30 marks/*markah*)

7. [a] Explain 5 major classes of contaminants.

Jelaskan 5 kelas utama bahan pencemar.

(25 marks/*markah*)

[b] What is static charge? Name 5 approaches to eliminate static charge.

Apakah cas statik? Namakan 5 kaedah untuk menghapuskan cas statik.

(25 marks/*markah*)

[c] With the help of diagrams, describe (i) trench-first dual damascene and (ii) via-first dual damascene processes.

Dengan bantuan gambarajah, huraikan proses-proses (i) "trench-first dual damascene" dan (ii) "via-first dual damascene".

(50 marks/*markah*)

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