Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	MATERIAL CHARACTERIZATION
COURSE CODE	:	BED 41303
PROGRAMME	:	BEJ
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) Resistance of the metal-semiconductor can practically quantify by contact resistance measurement.

(i) Distinguish **FOUR (4)** main categories of contact resistance measurement.
(4 marks)

(ii) Construct a vertical cross-sectional schematic diagram of contact resistance which includes diffused semiconductor layer. Support your answer with a resistance between two ends (A-B) diagram and label clearly.
(5 marks)

(b) Semiconductor device and circuit performance is generally degraded by series resistance that depends on the series and shunt resistance.

(i) Name **THREE (3)** factors that series resistance depends on
(3 marks)

(c) Atomic force microscopy (AFM) operates by measuring the force between a probe and the sample.

(i) Categorize **THREE (3)** operation modes of AFM technique and clarify each modes, respectively.
(9 marks)

(ii) Compare the type of sample that suitable to be inspected by AFM and Scanning Tunnelling Microscopy (STM).
(4 marks)

Q2 (a) Optical microscopy is the most versatile and useful instrument in a semiconductor laboratory.

(i) As an IC fabrication engineer, justify how sample can be analysed from the observed sample.
(2 marks)

(ii) Identify the limitation of feature sizes that can be observed using optical microscope.
(2 marks)

(iii) Deduce **THREE (3)** strengths of optical microscopy technique.
(6 marks)

(iv) Classify **TWO (2)** types of microscopy which can overcomes optical microscope resolution limit.
(2 marks)

(b) (i) Define Photoluminescence.

(2 marks)

(ii) Select **ONE (1)** of III-IV group element with direct bandgap material and explain briefly using band diagram

(5 marks)

(iii) Analyse **ONE (1)** strength and weakness of Photoluminescence measurement.

(2 marks)

(c) (i) Briefly distinguish the Raman spectroscopy technique.

(2 marks)

(ii) Analyse the information that can be determined by Raman

(2 marks)

Q3 (a) (i) List the function of X-ray fluorescence (XRF).

(3 marks)

(ii) Identify a situation where XRF is used to characterize the sample.

(4 marks)

(iii) Compare **TWO (2)** strengths and weaknesses of Secondary ion mass spectroscopy (SIMS).

(8 marks)

(b) (i) Analyse **THREE (3)** main specification of e – beam technique.

(6 marks)

(ii) In your opinion, analyse sample condition when there is charging issue occurred. Elaborate your answers with clear explanation.

(4 marks)

Q4 (a) (i) Electromigration can caused failure of semiconductor IC device. Analyse **TWO (2)** driving forces that triggered electromigration to occur.

(4 marks)

(ii) Examine **THREE (3)** examples of interconnect breakdown due to electromigration. (Sketch and label clearly)

(6 marks)

(b) (i) List **ONE (1)** material that is most suitable for scratch test.

(1 mark)

(ii) Analyse **FOUR (4)** main steps that involve to characterise thin-film samples using scratch test.

(4 marks)

(c) (i) Explain **TWO (2)** reasons why gate oxide is the most important parameter in MOS device.

(4 marks)

(ii) Given the static voltage of walking across vinyl floor condition is 12 kV with 20 % of relative humidity. However, the static voltage decrease to 0.2 kV when the relative humidity increases to 80%. Based on the situation, analyse how the static voltage versus relative humidity can affected machine durability performance.

(6 marks)

- END OF QUESTIONS -