UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(TAKE HOME)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	MATERIAL CHARACTERISATION
COURSE CODE	:	BED 41303
PROGRAMME	:	BEJ
EXAMINATION DATE	:	JULY 2020
DURATION	:	4 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS. **OPEN BOOK EXAMINATION**

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

Q1 (a) Ahmad was a postgraduate student at Universiti Tun Hussein Onn Malaysia. He was given a task from his supervisor to design a sensor device that having four – terminal pads. To complete his task, he needs to understand the resistivity theory. Determine and sketch the measurement technique that he need to used. Generate the resistivity, ρ formula and distinguish its unit. Given the resistivity of aluminium pad, ρ_{Al}= 2.65 x 10^{-8} Ω.m, width, W= 90 nm, thickness, t = 7000 Å and length, L = 10 μm. Based on your answer, calculate the resistance and sheet resistance values.

(10 marks)

(b) Ahmad has successfully designed the four-terminal pads for his sensor device after understand the resistivity theory. Apart from that, he also learnt the contact resistance measurement technique. **Figure Q1(b)** shows the top view image of the Greek cross test structure with four -terminal pads. Based on **Figure Q1(b)** specify the main principles of measuring four-terminal contact resistance. Considering the sample is thinner than the probe spacing and given the average voltage, V_{ave}= 10 V and average current I_{ave}= 5 mA. Calculate the average resistivity, ρ_{ave} value.

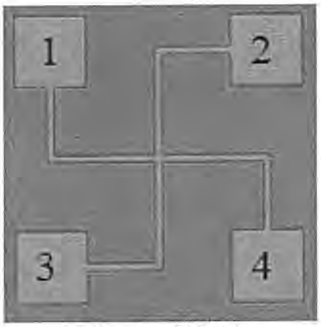

Figure Q1(b)

(10 marks)

Q2 (a) Advantage of corona charge was its "gates" over the oxide thickness.

(i) By using the corona charge process, justify how it can lower down the surface mobility of "corona" ions on the sample surface.

(5 marks)

(ii) In comparison to corona charge process, analyse the condition that may occurs on the conductive gate of sample surface when the voltage is applied.

(5 marks)

(b) Determine a measurement technique that suitable to examine the conducting and insulating samples. Explain its procedure or mode in details and sketch the diagram to support your answer. In your answers, analyse and explain which mode that suitable to be used for examine sample with pattern.

(10 marks)

Q3 (a) Polarized light can be used to measure and examine the uniformity of thin dielectric film thickness on Si substrate. Identify measurement tools that used polarized light and analyse its **THREE (3)** properties that use to validate the thickness measurement.

(6 marks)

(b) Based on your answer in **Q3(a)** suggest and propose in details **FIVE (5)** main procedure to examine the thin dielectric films thickness

(10 marks)

(c) Determine the suitable characterisation tools that use to measure crystallinity and detect stress condition of a thin-film sample without charging effect. From your answer, give example by sketching a diagram that showing the results of **THREE (3)** different crystallinity structure and also with different stress condition.

(4 marks)

Q4 (a) Identify the advance instrument that can characterise chemical and physical sample condition which resultant a black and white image with 2-dimensional (2D) structure. Based on your answer, analyse and compare the purpose of the measurement technique with another tool that can have a 3-dimensional (3D) structure.

(4 marks)

(b) Analyse the advantage of 2D advance instrument technique over optical microscope. Apart from examine the thin-film semiconductor samples suggest other research area that suitable to be applied.

(6 marks)

(c) Determine the advance instrument that use to study the surface structure and trace of radioactive. Explain each of the technique in details. Give an example of its application in industries that using these techniques.

(10 marks)

Q5 (a) As a failure analysis engineer, information of product failure rate can be presented in a curve. Name, sketch and explain the stage of the curve diagram in details. In your opinion, suggest and explain which stage have lower percentage of failure rate.

(5 marks)

(b) Analyse and explain **THREE (3)** main procedure of the technique that use to create as an image of **Figure Q5(b).**

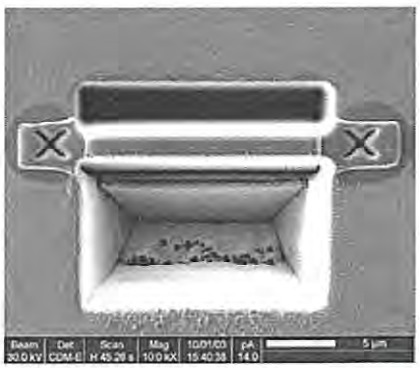

Figure Q5(b)

(5 marks)

(c) Categorise **TWO (2)** techniques to check the durability and performance of thin film device. Give example of each method and explain where it can be applied.

(5 marks)

(d) **Figure Q5(d)** shows the image of a sample after being measured with selected characterisation tool. Determine the measurement technique and explain in details the process.

Figure Q5(d)

(5 marks)

- END OF QUESTIONS -