2020

ELECTRONICS — HONOURS

Paper : DSE-B-1

(Semiconductor Fabrication and Characterization)

Full Marks : 50

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Question no. **1** is compulsory. Answer ***any four*** questions from the rest.

1. Answer ***any ten*** questions : 1×10

(a) Based on the arrangement of atoms, amorphous materials have

(i) Long-range order (ii) Short-range order

(iii) Both short and long range order (iv) No order.

(b) Epitaxy means

(i) Single-layer crystal (ii) Random deposition

(iii) Polycrystalline layer (iv) None of these.

(c) Crystal structure from XRD can be determined by using

(i) Bragg's law (ii) Boltzmann's law

(iii) Tauc's plot (iv) None of these.

(d) SEM is used to visualize

(i) Inner structure (ii) Atomic orientation

(iii) Surface morphology (iv) Chemical composition.

(e) The mean free path is the

(i) distance traveled by an electron between successive collisions.

(ii) average distance traveled by an electron between successive collisions.

(iii) maximum distance traveled by an electron between successive collisions.

(iv) None of the above.

(f) The air in a cleanroom is filtered by

(i) HEPA (ii) Fesh membrane

(iii) Filter paper (iv) None of these.

(g) A resist that becomes more soluble when exposed to illumination is called

(i) Positive photoresist (ii) Ultra photoresist

(iii) Active photoresist (iv) Superresist.

(h) In wet chemical etching of SiO_2, most commonly used etchant is

(i) HCl (ii) HF (iii) H_2O_2 (iv) HNO_3.

(i) In a metalization process for the fabrication of IC, Cu is used for

(i) Wafer material (ii) Interconnection and contacts

(iii) External casing (iv) None of these.

(j) Which of the following devices consumes least power?

(i) BJT (ii) JFET (iii) UJT (iv) MOSFET.

(k) UV spectroscopy is used

(i) to determine crystal structure (ii) to estimate bond gap

(iii) to visualize the surface (iv) to determine fracture.

(l) In AFM

(i) secondary e-beam is detected (ii) transmitted e-beam is detected

(iii) back scattered e-beam is detected (iv) inter atomic force is detected.

2. (a) What are homoepitaxy and heteroepitaxy? Give one example of each.

(b) Explain the process of MBE with a suitable figure.

(c) Write two advantages of MBE. (2+1)+5+2

3. (a) Draw the schematic of a Czocharlski-style grower used for producing substrate ingots and explain the process briefly.

(b) How Bridgeman method differs from the above technique?

(c) Define polycrystalline and amorphous material. 5+3+2

4. (a) What is diffusion process in carrier transport?

(b) Define diffusion coefficient and diffusion current density in the case of electron diffusion.

(c) State and prove Bragg's law for X-ray diffraction. 2+3+5

5. (a) What is Oxidation?

(b) Write short notes on the dry and wet oxidation processes.

(c) Illustrate the thermal oxidation process of Si wafer with a suitable figure of the total furnace assembly. 2+(2+2)+4

6. (a) What is photoresist?

(b) Compare positive and negative photolithography with suitable figures.

(c) Write a short note on electron beam lithography. 2+(2+2)+4

7. (a) What are isotropic and anisotropic etching?

(b) Write the advantages of dry etching.

(c) Compare contact printing and proximity printing techniques. (2+2)+3+3

8. (a) Why Si is mostly preferred in IC fabrication?

(b) What are the commonly used P-type and N-type dopants for Si?

(c) Explain briefly the fabrication steps of BJT with suitable diagrams. 3+2+5

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