Micro and nanotechnology

KMENT1ETND (English, BSc)

From 2016/2017

State exam's questions

1. Show the characteristic material formats of solid state, and the Miller – Bravais system used to describe the crystalline materials! Describe the crystal structure of the elementary semiconductors (Si, Ge)! Shortly describe the metallic, ionic, covalent, and molecule crystals! Summarize the different density definitions used in the crystallography!

2. Describe the experimental evidences of the material – wave duality of the matter! Show the band structure of the crystalline material! Describe the intrinsic and the extrinsic semiconductors! Give the continuity equation and explain its different components!

3. Explain the operation principle of the bipolar transistor, show the potential diagram and the current – voltage characteristics of the p – n junction (diode)! How the bipolar planar transistor, the resistor, and the capacitor produced by a bipolar IC technology?

4. Explain the operation principle of the MOS FET and the CMOS inverter! Show the basic steps of the CMOS technology using the CMOS inverter as an example!

5. Describe the photoelectric devices, show the differences between photo-diode, LED, and laser diode!

6. Describe the raw material production and the methods of the crystal growth and of the impurity removal! (Czochralski's and Bridgman's Method, Float-zone Process)

7. Describe the different layer growth techniques applied in the semiconductor device technologies (Liquid Phase Epitaxy, Vapor Phase Epitaxy, Molecular Beam Epitaxy)!

8. Describe the different layer deposition techniques of the the semiconductor device technologies (evaporation, sputtering, CVD, and the silicon-dioxide growth by thermal oxidation)!

9. Show the Atomic Layer Deposition process, explain its advantages!

10. Describe the Plasma Spray Deposition, show its place in between others deposition processes!

11. Describe the thermal diffusion process, show the profiles obtained by constant surface concentration and by constant amount of dopant!

12. Describe the ion implantation process, equipment, show the process advantages!

13. What are the pattern formation processes? Describe the photo-, the electron-lithography!

14. Describe the process and the equipment of electron lithography. Compare the electron-, X-ray- and ion-lithography!

15. Describe the basic material removal processes, compare the wet and the dry etching!

16. Describe the MEMS/NEMS systems, give some example for each!

17. Describe the bulk and the surface micromachining! Show the purpose of the sacrificial layer! Compare the MEMScap PolyMUMPS and the Draper dissolved wafer process!

18. Describe the LIGA process, explain the procedure of hot embossing!

19. Describe the FinFET structure, show its applications and its preparation process!