VLSI Technology

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Introduction to VLSI Technology, Crystal Growth, Oxidation, Epitaxial Process, Diffusion Process, Ion Implantation, Lithography, Etching, Metallization, VLSI Process Integration, Assembly Technique and Packaging, Yield and Reliability

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Introduction to VLSI Technology

1) Explain basic differences between Bipolar and MOS Integrated Circuits. **[UTU 2010]**

2) What are the advantages of Integrated circuits over discrete component circuits? **[UTU 2010]**

3) Give the steps used in the fabrication of ICs in a block diagram representation. **[UTU 2010]**

4) State Moore's law and explain the deviation from the predicted path. **[UTU 2012]**

5) Why cleaning of silicon wafer is necessary before any processing steps. **[UPTU 2007]**

Crystal Growth

6) List the key steps involved in obtaining pure Silicon. Explain with block diagram. **[UTU 2011]**

7) Discuss different steps in preparing wafers from the raw silicon with help of block diagram. **[UTU2012]**

8) Describe Cz process in detail with neat diagram. What is the Pull Rate in CZ technique? How the Pull Rate is controlled during the CZ crystal growth process? **[UTU 2010]**

9) Explain CVD process. Discuss its application. **[UTU 2010]**

10) A silicon ingot with 0.5×10^{16} boron atoms/cm^3 is to be grown by Cz method. What should be the concentration of boron in the melt to obtain the required doping concentration? The segregation coefficient of the boron is 0.8. **[UTU 2012]**

11) A boron-doped crystal is measured at its seed end with a four-probe of spacing 1 mm. The (V/I) reading is 10 ohms. What is the resistivity at seed end? **[UTU 2012]**

Oxidation

12) Why SiO_2 is an important component in electronics? **[UTU 2011]**

13) Explain the application of SiO_2 layer in IC fabrication. **[UTU 2012]**

14) Compare wet oxidation with dry oxidation. Why wet oxides are faster than dry oxides? **[UTU 2011]**

15) Why Oxidation is necessary in IC fabrication? Calculate the oxide thickness. Show that $\frac{x}{A/2} = \left[1 + \frac{t+\tau}{A^2/4B}\right]^{1/2} - 1$, reduces to $x = \frac{B}{A}(t+\tau)$ for short time and to $x = \sqrt{B(t+\tau)}$ for long time, where x = oxide thickness. **[UTU 2010]**

16) Compare High pressure oxidation and Plasma oxidation.

Epitaxial Process

17) What is Epitaxy? Discuss Molecular Beam Epitaxy technique in brief. What are the advantages of MBE over VPE? **[UPTU 2007]**

18) Explain the kinetics of Epitaxy. Calculate epitaxial layer thickness. What are the sources of silicon in VPE? **[UTU 2012]**

19) Why epitaxial layer of Si is necessary to grow? What are the functions of this layer in IC? **[UTU 2010]**

20) What is Autodoping? What are the disadvantages of Autodoping? How it can be minimized?

21) Explain vapor phase epitaxy and also tell what the sources of silicon in vapor phase epitaxy. **[UTU 2010]**

Diffusion Process

22) Derive the diffusion equation. How the depth of diffusion is controlled during diffusion process? Give the solution of Fick's Law? **[UTU 2010]**

Ion Implantation

23) Describe a typical ion implanter. What are the advantages of ion implantation? **[UTU 2012]**

24) What is Ion Implantation? Explain the process with a neat diagram. **[UTU 2010]**

25) What do you mean by Annealing? Why it is required in IC fabrication process? **[UTU 2012]**

26) Compare ion implantation process with diffusion. **[UTU 2012]**

Lithography

27) List the defects in pattern transfer. **[UTU 2012]**

28) List all process steps of pattern transfer with diagram. **[UTU 2012]**

29) What are PR materials? Describe all types of PR. What are the properties of PR? **[UTU 2012]**

30) Explain proximity printing and projection printing & compare these two.

31) List and compare different types of lithography techniques. **[UPTU 2007]**

32) Explain ion beam lithography process. **[UTU 2012]**

33) What are the requirements of a photoresist? Which photoresist is preferred for better resolution and why? **[UPTU 2007]**

34) Describe ion beam lithography in brief. **[UPTU 2006]**

35) Describe various printing techniques in lithography. Which one is better and why?

36) What is the difference between positive and negative photoresist? Which photoresist is preferred for better resolution and why? **[UPTU 2006]**

37) List and explain all the steps of pattern transfer using photo lithography process.**[UTU 2011]**

38) What is X-Ray lithography? Describe advantages and problem areas associated with X-Ray lithography.

Etching

39) What is plasma? Draw an equivalent circuit for RF plasma discharge. **[UPTU 2006]**

40) What are the figures of merit of etching system? Compare anisotropy and isotropy etching.

41) Explain all properties of etchant. **[UTU 2012]**

42) What is reactive ion etching? Describe its damages. **[UPTU 2006]**

43) What is etching? Describe wet etching for silicon with all steps. Also discuss problems with wet etching

44) Describe the sputtering etching with neat diagram.

Metallization

45) How the thickness of deposited film is measured?

46) Why Metallization is required? What advantages and applications it provide the ICs? **[UTU 2010]**

47) What do you mean by sputtering? How it is used in etching and metallization? Describe various advantages and problems with sputtering?

48) Explain the metallization and also describe the problems associated with this process. Explain sputtering method of metallization. **[UTU 2012]**

49) What are the limitations of pure aluminum metallization for sub-micron level devices? **[UPTU 2006]**

VLSI Process Integration

50) Describe DRAM and SRAM semiconductor memories. **[UPTU 2006]**

51) With neat diagram explain fabrication process sequence for NMOS IC technology. **[UPTU 2006]**

52) Give the various fabrication steps of npn transistor with diagram and brief explanation. **[UTU 2012]**

53) Why <100> orientation is preferred over <111> orientation for starting material in NMOS/CMOS IC fabrication. **[UPTU 2006]**

54) What is the “hot electron problem” in NMOS IC? How it can be minimized?

55) Explain CMOS inverter Voltage transfer characteristic with a neat diagram. Explain fabrication process for n-tub CMOS IC. **[UPTU 2006]**

56) Give the various fabrication steps of CMOS transistor using n well technique with diagram and brief explanation. **[UTU 2012]**

57) What are the stored charge and the number of electrons on an MOS capacitor with an area of 4 μm^2, a dielectric of 200 $\overset{0}{A}$ thick SiO_2, and an applied voltage of 5V?

58) Describe various effects if the channel doping is either too low or too high in NMOS IC technology.

59) Discuss various CMOS structures and describe p tub, n tub and twin tub structures.

Assembly Technique and Packaging

60) Write short note on package types and packaging design VLSI Technology. What is meant by DIP? Explain in brief. **[UTU 2012]**

61) Write a short note on VLSI assembly technologies. Describe the different VLSI assembly technologies.

62) What are the Package types in VLSI? Describe packaging design consideration in VLSI.

63) What is Assembly technique? Write the Applications also.

64) How is packaging evaluated for VLSI design? Discuss the types of packaging design consideration.

Yield and Reliability

65) Write a detailed note on different yield loss mechanisms in VLSI. **[UTU 2012]**

66) Explain why modeling of yield loss mechanisms is required. Explain general model of yield loss mechanism and also explain accelerated testing in brief. **[UTU 2012]**

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68) What are the requirements of reliability?

69) Explain Yield loss in VLSI. Describe the yield loss modeling.

70) Explain the Yield & reliability in terms of VLSI technology. Explain how is accelerated testing performed?