MS3012 – Micro/Nanoelectronic Processing

Course Code	MS3012					
Course Title	Micro/Nanoelectronic Processing					
Pre-requisites	NIL					
Pre-requisite for	MS4014	Nanomaterials: fundamentals and applications				
No of AUs	3					
Contact Hours	LECTURES	26 hrs	TUTORIALS	13 hrs		

Course Aims

This course is an introduction to advanced materials processing, with focus on micro/nano-electronics. It is essential for those of you who desire to specialize in microelectronics device fabrication. It also serves as a pre-requisite for the more advanced microelectronics elective modules offered in their fourth year.

This subject includes an introduction to fundamental semiconductor operation and device physics. The course covers the basics of semiconductor technology, from bare silicon to finished products. The process steps include bulk crystal growth, oxidation, diffusion, ion implantation, thin film deposition, lithography and etching. Factors that affect the materials' properties from the process steps will be highlighted. New materials that are incorporated into the state-of-the-art semiconductor processes are also discussed. Advanced techniques in lithography and film deposition are introduced, as well as advanced novel devices.

Intended Learning Outcomes (ILO)

By the end of the course, you should be able to:

1. Calculate carrier resistivity, conductivity and carrier concentration of a doped semiconductor.
2. Explain how doping concentration affects resistivity, conductivity, carrier mobility in Silicon.
3. Explain the purpose of typical silicon wafer manufacturing processes, including thermal oxidation, diffusion, ion implantation, physical/chemical vapor deposition, photolithography and etching processes.
4. Determine specific process parameters such as : thermal oxide thickness, junction depth, surface concentration, thin film thickness etc.
5. Determine the mask thickness to block implantation ions.
6. Evaluate and determine the best process to deposit oxide of various thickness and dimensions.
7. Evaluate and determine the best process for doping Silicon at the source drain, n-well, p-well, etc.
8. Calculate the parameters associated with etching based on etch selectivity, rates and anisotropy
9. Correlate how the parameters of the deposition process (eg. Pressure, temperature, ion energy) affects film uniformity and quality both from a qualitative and quantitative point of view
10. Choose the type of photolithography process flows based on the context provided.
11. Evaluate the various deposition techniques to choose the appropriate processes based on the material deposited as well as the desired quality
12. Explain the dependencies that affect resolution and related parameters in optical lithography systems

Course Content

Microelectronics Technology Overview. Overview of semiconductor Device Physics. Diffusion and Thermal Oxidation. Ion Implantation. Chemical and Physical Thin Film Deposition. Patterning, Lithography.

Reading and References

Textbooks

1. J. D. Plummer, M. D. Deal and P. B. Griffin, Silicon VLSI Technology, 2000, Prentice Hall.
2. S. M. Sze, Semiconductor Devices (Physics and Technology), John Wiley & Sons, 2002, 2nd edition

References

1. S. Campbell, The Science & Engineering of Microelectronic Fabrication, 1996, Oxford.
2. S. M. Sze, VLSI Technology, 1988, McGraw Hill.
3. Y. Chang and S. M. Sze, ULSI Technology, 1996, McGraw Hill.
4. S. K. Ghandhi, VLSI Fabrication Principles, 1994, John Wiley.
5. H. H. Lee, Fundamentals of Microelectronics Processing, 1990, McGraw Hill.

Course Policies and Student Responsibilities

(1) CA

Absentees must be supported by a medical certificate or other valid official documents

(2) Class participation

Students participate by answering Responseware questions and their answers are tabulated. No marks will be given if they are absent.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.