[ELEC 4520] [Integrated Circuit Fabrication Technology] [Spring 2024] [Credits: 3]

Course Description

For UG students only. The course is intended to provide students with fundamental knowledge in device and integrated circuits (IC's) fabrication. The class covers the modules of device fabrication (including clean room concept, cleaning procedures, diffusion, lithography, wet processing, dry etching, chemical vapor deposition, sputtering) and process integration to form IC's. The lab section will bring the students with hands-on experience in IC fabrication facilities in Nanoelectronics Fabrication Facility of HKUST. Prerequisite(s): ELEC 3500

List of Topics

Lecture Outline

Week 1 Course introduction, lab arrangement, cleanness and cleanroom
Week 2 Introduction to IC Fabrication Technology
Week 3 Typical loop of IC fabrication and process flow of an NMOS
Week 4 Process integration of a simple NMOS
Week 5 Lithography I
Week 6 Lithography II
Week 7 Oxidation
Week 8 Chemical vapor deposition
Week 9 Etching
Week 10 Doping
Week 11 Metallization
Week 12 Back-End-Of-Line Technique
Week 13 Process integration

Laboratory Outline

1. Introduction to NFF and Safety Training
2. Standard Cleaning
3. Pad Oxidation and Nitride Deposition
4. Active Area Lithography
5. Nitride Etch and Field Oxidation
6. Pad Nitride Strip and Threshold Implantation, Buffer Oxide Removal and Gate oxidation
7. Polysilicon Deposition, Gate Definition, Polysilicon Etch and Photoresist Strip
8. Source/Drain Implant, LTO Deposition and Densification and Backside Etching etc.
9. Etching, Al Deposition, Al Lithography, Al Etching and Al Sintering
10. Device Measurement and Process Simulation; an example for simulation

Intended Learning Outcomes:

On successful completion of this course, students will be able to:

1. Define the protocols and operational standards of a cleanroom.
2. Identify the basic operational principles of semiconductor fabrication equipment.
3. Explain the process modules available in IC fabrication.
4. Design process flows of IC fabrication technologies.
5. Evaluate effects of process parameters on final transistor characteristics.
6. Apply measurement skills for microelectronic devices and IC characterization.

Textbook(s):

No required textbook

Reference Books/Materials:

1. S. M. Sze, M. K. LEE, Fundamentals of semiconductor fabrication, *Wiley*, 2003.
2. James D. Plummer, Michael Deal and Peter B. Griffin, Silicon VLSI technology: fundamentals, practice and modeling, *Prentice Hall*, 2000.
3. Stephen A. Campbell, Fabrication Engineering at the Micro- and Nanoscale, *Oxford University Press*, 2008, 3rd ed.
4. S. M. Sze and K. K. Ng, Semiconductor devices: physics and technology, *Wiley*, 2006, 3rd ed.
5. Chang LIU, Foundations of MEMS, *Prentice Hall*, 2011.

Relationship of Course to Program Outcomes:

Please refer to the Report Section 4.3.2 (iii).

Grading Scheme:

Lab reports	30%
Quizzes	30%
Final Examination	40%
Attendance	-5% for each missing lab