Boston University

EC 578 FABRICATION TECHNOLOGY OF INTEGRATED CIRCUITS

Prerequisite:	EC 410
Professor:	Kleptsyn
Class hours:	MW 2:30-4:15
Office hours:	MW 4:15-5:00
Credits:	4
Maximum number of students	12

Books:
Sami Franssila. Introduction to Microfabrication, 2nd edition. 2010.
Other recommended books:
Richard C. Jaeger. Introduction to Microelectronic Fabrication. 2002
James D. Plummer, Michael D. Deal, Peter B Griffin. Silicon VLSI Technology. 2000
S.K.Ghandhi. VLSI Fabrication principles 1996.

COURSE CONTENTS

1. Silicon. Material properties, single crystals, crystal structures, unit cells, crystallographic planes, Miller indices. Defects and impurities in crystals.
2. Doping, p- and n-types of semiconductors, band gap.
3. Electronic properties of silicon. Bonds and bands, band structure, impurity energy levels.
4. Silicon wafers, wafer fabrication, wafer cleaning, surface preparation. Ion implantation. SOI wafers.
5. Oxidation, kinetics of oxidation, wet and dry oxidation, color chart. Thin film measurements, ellipsometry, FTIR, interference microscopy.
6. Phase diagrams, solid solubility. Diffusion, Fick's laws, diffusion from a unlimited and from limited source; interstitial and substitutional diffusion, diffusion coefficient, activation energy. Design of the diffusion process.
7. Photolithography and masks. Mask design and fabrication.
8. Silicon processing in detail (wafer level).
9. Photoresist deposition, baking, aligning, developing, BOE etching, photoresist removal.
10. BJT design and fab. Field effect, MOSFETs. MOSFET design and fabrication steps.
11. Silicon wet etching and reactive ion etching. DRIE.

12.Metal deposition techniques. Contacts. Lift-off process.
13.Etching metallic films.
14.Miscellaneous techniques.
15.Measurement and characterization techniques

In a separate lab section students will use their theoretical background to fabricate semiconductor devices (wafer level) and acquire the skills needed to do research on solid state devices.

PROJECT

In this course the practical aspects of the fabrication process are the main focus of attention. Basics and theoretical aspects including calculations of the physical processes and parameters will be given and considered accordingly.

The first and the main goal of this course is to guide students through the practical steps of making an integrated circuit of their own design. As a rule, those steps including measurements and inspection will be supposed to perform manually for more profound understanding of the physical and chemical processes.

The project consists of three main portions:

1. Design. Students will have to design a circuit (e.g. amplifier), transistors, masks and technological process of the fabrication on the wafer level.
2. Fabrication. Students will perform all necessary technological steps starting with plain wafer; the wafer containing a few hundred patterned chips should be presented at the end of the course.
3. Inspections and tests will have to be done after each technological step/operation. Final wafer inspection may include measuring electrical parameters on a probe station.

Grading: Homework 20%, Labwork 50%, Final 30%.