Department of Materials Science and Engineering
MSE 467 Materials Science & Engineering
Electronic Materials (3 credits)
Offered jointly with EE 486

Catalog Description
Materials and processes used in the manufacture of electronic components. Basic principles of crystal growth, deposition, doping, diffusion, component delineation and packing as they apply to hybrid and integrated circuits and devices.

Prerequisites:
Background in basic materials science and engineering and in electronic circuits, and an introductory course in electronic materials (such as MSE 466)

Textbook:
Steven A. Campbell, The Science and Engineering of Microelectronic Fabrication, Oxford University Press.

Course Objectives: At the end of this course, students will be able to:

1. Describe and discuss the materials used in hybrid and integrated circuits
2. Design a process sequence for manufacture of microelectronic chips.
3. Simulate the results of a process sequence.
4. Explain how the limitations of the materials and fabrication methods lead to limitations in device characteristics.

Topics Covered:

1.Historical Overview (Chap. 1; 0.5 weeks)
2.Process Overview (Chap. 2; 0.5 weeks)
3.Thermal Oxidation of Silicon (Chap. 3; 1 week)
4.Introduction to Vacuum Technology (0.5 weeks)
5.Deposition of Thin Films (Chap. 4; 1 week)
6.Lithography (Chap. 5; 1 week)
7.Etching (Chap. 6; 0.5 weeks)
8.Epitaxy (Chap. 7; 1 week)
9.Impurity Diffusion (Chap. 8; 1.5 weeks)
10.Ion Implantation (Chap. 9; 0.5 weeks)
11.Process Simulation using SUPREM (1 week)
12.Design Considerations (0.5 weeks)
13.Material and Device Characterization (Chaps. 10, 11; 0.5 weeks)

Class Schedule:
The class meets 3 times weekly for 50 minutes each. It is team taught with an instructor from Electrical Engineering. In lieu of a final exam, students are assigned a comprehensive computer-based design project involving the design of a process sequence, its simulation, and design of appropriate masks. An associated 1 credit laboratory runs concurrently (offered as MSE 498).

Contribution of course to meeting the professional component:
This course is an important elective for those students interested in the electronics industry. The course uses real examples and the students are able to design real systems using computer software of the type used in industry. Along with the associated lab, this course provides experience in a real semiconductor processing environment.

Contribution of course to program objectives
This course applies math, science and engineering knowledge and requires student to design and conduct simulation experiments via computer. Students also design partial and complete process sequences for the fabrication of silicon devices with specified characteristics, thus solving engineering problems. In reviewing the societal impact of the increased complexity and lower cost of modern silicon integrated circuits,
we also discuss the potential for future improvements, and consider the changes that may result from them. They are also required to communicate the results of their final project in such a way that it is understandable to a technically informed (but not specialist) audience.

Prepared by: Thomas Stoebe, Professor, April 2001