Course Syllabus

Department/Faculty
School of Engineering

Graduate Program
Materials Engineering and Nanotechnology

Degree
☒ Academic Master's ☒ Doctorate (PhD) ☐ Professional Master's

Course Name
Microfabrication Techniques

Professor(s)
Prof. Cecilia de Carvalho Castro e Silva

Office hours
48

Course Overview

Advanced products such as computers, solar cells, cell phones and (biological) sensors are manufactured using microfabrication techniques. Knowledge about micromanufacturing processes is a crucial factor for the advanced manufacturing industry, but also for emerging technologies in start-ups. In this subject, the student will learn to work in a clean room environment, procedures and applications of microfabrication technologies, from the classic processes of lithography, deposition and etching to new technologies for manufacturing devices.

Topics outline

i) Practical concepts for working in a clean room environment.
ii) Deposition process. Chemical vapor deposition (CVD). Practical example: Growing graphene by CVD. Physical vapor deposition (PVD). Practical example: Deposition of metallic thin films by electron beam (e-beam).
iii) Lithography. Describe in detail the two main methods of pattern transfer: electron beam lithography and optical lithography. Practical example: lithography for transferring patterns for metallic contact in graphene devices.
iv) Corrosion. The process of wet and dry corrosion will be addressed. The anisotropic corrosion process via reactive ion plasma (RIE). Practical example: corrosion of silicon nitrite using RIE. The wet process (in a liquid environment) will be discussed. The main chemical reactions involved in the process will be presented, as well as the isotropic attack. Practical example: use of HF buffer for corrosion of silicon dioxide layer.
v) Characterization: Device characterization methods by optical and electrical techniques.
vi) Advanced microfabrication technologies. In this topic, the new micromanufacturing processes of devices for optoelectronic, electrical and (bio)sensing applications will be discussed. Focused Ion Beam (FIB) for nanofabrication. Fabrication of microfluidic devices with soft lithography. 3D printing and inkjet printing.

Letter Grade Assignment
Grade A (Excellent) - Grade points between 9 and 10
Grade B (Good) - Grade points between 8 and 8.9
Grade C (Satisfactory) - Grade points between 7 and 7.9
Grade D (Unsatisfactory) - Grade points between 0 and 6.9

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Texts, Materials, and supplies

- M. Madou, Fundamentals of Microfabrication, 2nd edition, CRC Press, Boca Raton (2002).
- R. C. Jaeger,Introduction To Microelectronic Fabrication, V 5, 2nd edition, Prentice Hall (2002).