Syllabus

Special Topic ST:PHY5937 Device Prototyping

HPA1 0363, Credits: 3(0,3). TuTh 9-11 a.m. PSB 440

Prof: Robert E. Peale, PS423, Robert.peale@ucf.edu

Office hours: MW 3:30-4:30.

**Prerequisites:** Graduate standing or consent of instructor.

**Course Description:** Fabrication and characterization of micro-scale devices, including micro-electrical-mechanical systems, sensors, optical devices, and micro-fluidic devices.

**Goals and objectives:** Learn the techniques of fabricating and characterization micro-scale devices in a hands-on clean-room environment. Topics include photo- and electron-beam lithography, electron-beam evaporation, sputtering, metal lift-off, reactive ion etching, inductively coupled plasma etching, barrel ashing, wet etching, plasma-enhanced chemical vapor deposition, sacrificial layers, optical microscopy, profilometry, microprobe-station, 4-point probe resistivity measurement, scanning electron microscopy, UV-visible spectroscopy, atomic force microscopy. A goal is that students who pass this course can be given key-card access to the facilities to begin their dissertation research.

**Required text:** S. Wolf and R. N. Tauber, Silicon Processing for the VLSI Era, Volume 1-Process Technology, (Lattice Press, Sunset Beach, CA 1986).

**Course calendar:**

First month: Environmental Health and Safety training, Photolithograpy, descum, metal deposition, and lift-off. Optical microscopy.

Second month: PECVD oxide growth, wet etching. Profilometry. 4 point resisitivity measurement.

Third month: RIE-ICP etching, barrel-ashing, scanning electron microscosopy, Electron-beam lithography, UV-vis spectroscopy, atomic force microscopy.

Fourth month: Make and characterize final project device: Deep fluid channels, optical planer waveguides, air-bridges, cantilevers,

**Course assignments (assignments and exams)**: This is a hands on laboratory with all class time spent in the physics Microdevice Prototyping Facility (MPF). There will be assigned reading, one midterm and a final based on the assigned reading and standard operation procedures for the instruments in MPF, and a final fabrication project.

**Methods of evaluation:** Participation will count for 25%, midterm 25%, final project 25%, final exam 25%. The final course grade will be available on myucf.

**PHYSICS DEPT MISSED WORK POLICY:** M*aking up missed work is permitted only for UCF-sanctioned activities and bona fide medical or family reasons.* ***Authentic justifying documentation must be provided in every case (in advance for UCF-sanctioned activities).*** *The form of the make-up will be determined by the instructor.*

First month:

1. Environmental Health and Safety training (Basic. Online and in-lab practical).
2. Cleanroom etiquette.
3. Traveler sheets.
4. Photolithograpy (Spinner, hot plate, mask aligner, grating masks, squares).
5. Descum (Samco and Barrel Asher)
6. Metal deposition (Electron-beam evaporators, Cressington, MRC, thermal evaporation)
7. Lift-off. (Chemical hood)
8. Optical microscopy (Record images, Lateral dimensions).
9. Profilometry (Measure metal thicknesses).
10. Deliverable: Report results.

Second month:

1. PECVD oxide growth on metal squares.
2. Resist mask on squares.
3. Wet etch oxide in BOE to Si substrate.
4. Dry etch oxide (Barrel asher, trion) to substrate).
5. Strip resist
6. Undercut etch into Si on Barrel asher.
7. Dry etch to remove oxide mask.
8. Deliverable: Report results.
9. Mid term

Third month:

1. scanning electron microscosopy,
2. Electron-beam lithography,
3. 4 point probe.
4. UV-vis spectroscopy,
5. Atomic force microscopy.

Fourth month:

1. Deep fluid channels,
2. optical planer waveguides
3. Final Project
4. Final Exam