

University of Southern California
Ming Hsieh Department of Electrical and Computer Engineering

Course Number & Title:	EE507: Micro- and Nano-Fabrication Technology
Units:	4
Semester:	Fall
Schedule:	Class: M, W 2-4pm
Location:	THH 114
Instructor:	Wei Wu
Office:	PHE 632
Office Hours:	T 4-5
Contact Information:	wu.w@usc.edu , 213-740-3085
Teaching Assistant:	Deming Meng

Catalogue Description:

Fundamentals of micro- and nano-fabrication technologies, and the science behind those technologies.

Course Description:

Micro- and nano-fabrication are enabling technologies for micro/nano-device and micro/nano-science researches. While both were mainly invented throughout the progress of the semiconductor industry, their applications have gone beyond semiconductor devices and circuits. Understanding the science and technology of micro- and nano-fabrication becomes an essential foundation of successful research in the frontier of electronics, photonics, and circuits.

EE 507 and EE 508 form a two-course sequence in micro/nano-fabrication, and the courses can be taken in either order. EE 507 focuses on the non-lithography technologies. Those include how to manufacture semiconductor substrate, various thin film deposition, etching and material modification technologies.

Learning Objectives:

The goal of EE 507 is to:

- 1) Survey the landscape of state-of-the-art micro/nano-fabrication technologies.
- 2) Understand the fundamental sciences behind micro/nano-fabrication.
- 3) Provide a starting point for micro/nano-fabrication research.
- 4) Learning the tools

Prerequisite: Graduate standing in Engineering, Physics, or Chemistry

Main Text Book:

“Fabrication Engineering at the Micro and Nanoscale”, by Stephen A. Campbell, Fourth Edition, Publisher: Oxford University Press, 671 pages, ISBN-13: 978-0199861224

Supplementary Texts: Handout slides and reading assignments are provided in class.
Readings: All lecture notes will be available on Blackboard.

Grading:

Homework	10%
Presentation	10%
Project	10%
Midterm Exam	30%
Final exam	40%

Tentative Weekly Schedule

1. Introduction and overview of lithography technologies
2. Overview of lithography technologies and overview of pattern transfer
3. Photolithography fundamentals (first homework)
4. Resolution enhancement technologies: immersion, off-axis illumination
5. Resolution enhancement technologies: phase-shift mask, optical proximity correction, double processes (second homework)
6. Wrap-up photolithography, EUV lithography (system, light sources)
7. EUV lithography (optics, mask, resist and challenges), other photon-based lithographies: interference lithography (third homework)
8. Other photon-based lithographies: phase-mask lithography, maskless lithography, double-photon lithography (fourth homework)
9. Mid-term exam, Electron-beam lithography and SEM
10. Electron-beam lithography and SEM
11. Electron-beam lithography and SEM (fifth homework)
12. Focused-ion-beam lithography, Helium-ion-beam lithography (sixth homework)
13. Nanoimprint lithography and soft lithography (seventh homework)
14. Pattern transfer/etching
15. Student presentations

Homework

Some of homework questions are from the textbook, and some homework question (mainly something to think about) are from the instructor.

Project

The project is to design a fabrication process to manufacture short channel finFET transistor. This is basically to mimic fabrication process development for the next generation technology node. Synopsis sprocess is used in the process design and verification. This is the same software used in industry. The first three simulation assignments are used to design and verify certain components of the fabrication process. The final assignment is integrate the entire fabrication process.

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, “Behavior Violating University Standards” <https://policy.usc.edu/scampus-part-b/>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

Support Systems:

Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. <https://engemannshc.usc.edu/counseling/>

National Suicide Prevention Lifeline - 1-800-273-8255

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. <http://www.suicidepreventionlifeline.org>

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. <https://engemannshc.usc.edu/rsvp/>

Sexual Assault Resource Center

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: <http://sarc.usc.edu/>

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086

Works with faculty, staff, visitors, applicants, and students around issues of protected class. <https://equity.usc.edu/>

Bias Assessment Response and Support

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. <https://studentaffairs.usc.edu/bias-assessment-response-support/>

The Office of Disability Services and Programs

Provides certification for students with disabilities and helps arrange relevant accommodations. <http://dsp.usc.edu>

Student Support and Advocacy – (213) 821-4710

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. <https://studentaffairs.usc.edu/ssa/>

Diversity at USC

Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. <https://diversity.usc.edu/>

USC Emergency Information

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible, <http://emergency.usc.edu>

USC Department of Public Safety – 213-740-4321 (UPC) and 323-442-1000 (HSC) for 24-hour emergency assistance or to report a crime.

Provides overall safety to USC community. <http://dps.usc.edu>