ECH6905      Semiconductor Device Fabrication Laboratory

1. Catalog Description – (2 credits) The overall goal is to provide students with hands-on experience in semiconductor material characterization and device fabrication techniques.

2. Pre-requisites and Co-requisites: None

3. Course Objectives -
   a. Students will gain hands on experience with semiconductor based processes, units, and corresponding equipment through lab experiments.
   b. Students will gain practical experience to design and fabricate the devices.
   c. Students will demonstrate an understanding of basic engineering statistics in their laboratory reports.
   d. Students will demonstrate familiarity and experience with the measurement of process variables (e.g. temperature, pressure) using manual and/or electronic devices and computers.
   e. Students will be able to use the scientific method and problem solving strategies, as well as statistical methods, to design and carry out experiments in order to solve engineering problems.
   f. Students will demonstrate familiarity and experience with the capabilities and limitations of semiconductor process equipment.
   g. Students will understand and practice safe laboratory and chemicals-handling principles.
   h. Students will be able to integrate topics from various semiconductor processing steps to solve realistic problems in the areas of material and device characterization.
   i. Students will exhibit critical and creative thinking skills for analysis and evaluation of problems and cause-effect relationships.
   j. Students will be able to obtain and evaluate appropriate informational/data from databases, handbooks, correlations, experiments, literature, etc.
   k. Students will be able to rationalize units, make order of magnitude estimates, assess reasonableness of solutions, and select appropriate levels of solution sophistication.
   l. Students will be able to write effective, well organized technical reports, including formal engineering reports and short letter reports.
   m. Students will demonstrate effective reading of technical material.
   n. Students will demonstrate effective interpretation of graphical data.
   o. Students will practice good teamwork principles.
   p. Students will gain general concepts of estimating mass-transfer coefficients and use them to determine mass-transfer rates across phase boundaries during oxide growth.
   q. Students will demonstrate knowledge of photolithographic chemistry.
   r. Students will understand fundamentals of vacuum deposition including thermal evaporation and sputtering deposition during laboratory experiments.
4. Contribution of course to meeting the professional component:  N/A

5. Relationship of course to program outcomes: N/A

6. Instructor -
   a. Office location: CHE 317
   b. Telephone: 352-392-4727
   c. E-mail address: ren@che.ufl.edu
   d. Class Web site: www.che.ufl.edu/ren/
   e. Office hours: Tuesday 9:30-11:00 AM

7. Teaching Assistant -
   a. Office location: CHE 119
   b. Telephone: 352-846-2989
   c. E-mail address: yahsihwang@ufl.edu; camilovelez@ufl.edu
   d. Office hours: Friday 10:00-12:00 AM

8. Meeting Times – TBD

9. Class/laboratory schedule:  13, 3-hour labs, each requiring a pre-lab assignment, 5 min start quiz and a laboratory report. In addition, there are a poster presentation and a final exam.

10. Meeting Location – NRF

11. Textbooks and Software Required – None.

12. Recommended Reading -
    


13. Course Outline (provide topics covered by week or by class period) –

    Module 1.  Lab Safety, orientation and ethics
    Module 2.  Hall measurement
    Module 3.  Four point measurement, transmission line method, Schottky diode characterization
Module 4. Field effect transistor and bipolar transistor characterization
Module 5. Mask design
Module 6. Ion implantation simulation
Module 7. Wet and dry etching
Module 8. Oxide growth
Module 9. Ohmic metal deposition using a sputtering system
Module 10. Gate electrode photolithography
Module 11. Gate electrode deposition using thermal evaporation of a system
Module 12. MOS diode characterization; oxide breakdown strength, carrier concentration and interface trap density measurements
Module 13. Final exam
Module 14. Poster presentation

14. Attendance and Expectations - Cell phones and other electronic devices are to be silenced. No text messaging during class or exams.

Requirements for class attendance and make-up exams, assignments, and other work are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

Dress code – Protective eyewear and protective gloves will be available and must be worn at all times while in the laboratory. Long pants and close-toed shoes must be worn in the laboratory (no sandals). Those who do not follow the dress code will not be allowed in the laboratory. No food and drinks of any kind (including chewing gum) are allowed in the laboratory.

15. Grading –

5% start quiz  
20% Attendance  
20% Pre-labs  
20% Lab reports  
20% Poster presentation  
15% Final exam  
100% TOTAL

Report Submission: The deadline for the pre-lab submission is the beginning of each experiment and the deadline for the final report submission is 48 hours after the experiment. You need to electronically submit your final report to the instructor and TAs. Please work ahead to ensure that your report is finished on time.

There will be four people in a group for the lab and each group needs to submit one final report for every lab. However, everyone in the class needs to submit his or her prelab report to TA.
• 80% if turned in within 12 hrs after the deadline
• 60% if turned in within 24 hrs after the deadline
• 50% if turned in between 24 and 48 hrs after the deadline
• 0% if turned in 48 hrs after the deadline

16. Rules for the poster. New teams will be formed and only two people are allowed in each team. Here are the deadlines for the poster:
   a. Two possible subjects or titles of the poster need to be emailed to the instructor by the end of January 25th. (1 point)
   b. Instructor will choose one of the submitted subjects for you by the end of January 28th.
   c. Submit five papers related to the topic of your poster by February 8th. (2 points)
   d. Submit a draft of the abstract with 300 to 350 words by February 15th. (2 points)
   e. Submit an revised abstract and the plots and tables which will be used in your poster by the end of March 1st. (3 points)
   f. Submit a draft of your poster by the end of March 22nd. (2 points)
   g. Poster presentation will be held on the week of April 8th from 8:30 AM to 11:AM. (10 points)

17. Grading Scale
   A: 93-100
   A-: 90-92
   B+: 87-89
   B: 83-86
   B-: 80-82
   C+: 77-79
   C: 73-76
   C-: 70-72
   D+: 67-69
   D: 63-66
   D-: 60-62
   E: 0-59

“Undergraduate students, in order to graduate, must have an overall GPA and an upper-division GPA of 2.0 or better (C or better). Note: a C- average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. Graduate students, in order to graduate, must have an overall GPA of 3.0 or better (B or better). Note: a B- average is equivalent to a GPA of 2.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

18. Make-Up Exam Policy - If you have a University-approved excuse and arrange for it in advance, or in case of documented emergency, a make-up exam will be allowed
and arrangements can be made for making up missed work. University attendance policies can be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

Otherwise, make-up exams will be considered only in extraordinary cases, and must be taken before the scheduled exam. The student must submit a written petition to the instructor two weeks prior to the scheduled exam and the instructor must approve the petition.

19. Honesty Policy – All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

“…failure to comply with this commitment will result in disciplinary action compliant with the UF Student Honor Code Procedures (http://www.dso.ufl.edu/scrr/procedures/honorcode.php)

20. Accommodation for Students with Disabilities – Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

21. UF Counseling Services – Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
   · UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
   · Career Resource Center, Reitz Union, 392-1601, career and job search services.

22. Software Use – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.