Spring 2026 Microfabrication and Thin Film Materials

Instructor: John Prineas, Professor
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Department: Department of Physics and Astronomy
Department Office is in 203 Van Allen
Department Executive Officer is Professor Mary Hall Reno
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Course location & times: Van Allen 470, TuTh 2:00 – 3:15 pm
Course website: icon.uiowa.edu

Course description: Micro/nano-fabrication techniques and thin-film materials growth underlie modern electronic and optoelectronic devices. This course introduces fabrication techniques, physics, and chemistry, as well as the growth and properties of thin films on which fabrication is performed. Students gain hands-on experience with cleanroom processes while reviewing materials science, vacuum technology, micro/nano-device structures, thin-film deposition, plasma etching, patterning, characterization, and film nucleation, growth, structure, and properties.

Prerequisites: A solid background in thermal, modern, and statistical physics, chemistry, differential equations, and physical sciences and engineering is recommended.

Texts: Materials Science of Thin Films, 2nd Ed., Milton Ohring (2002)
Fabrication Engineering at the Micro- and Nanoscale, 4th Ed., Stephen Campbell (2012)

Note: Ohring provides the materials science and thin-film physics foundation of the course, while Campbell is used selectively to clarify lithography, etching, and process integration.

Additional References:

1. Introductory MEMS: Fabrication and Applications, T.M. Adams, R.A. Layton (2010)
2. Thermodynamics of Materials, Qing Jiang and Zi Wen (2011)
3. Micro and Nano Fabrication: Tools and Processes, Hans H. Gatzen, Volker Saile, Jürg Leuthold (2015)
4. Miscellaneous journal articles that will be posted to the website

Format: Two lectures will be given a week. Problem sets and labs will be assigned periodically. A final exam will be given.

Homework: Problem sets and lab homeworks and due dates will be announced in class and on the course website on ICON. Homework problem solutions will be available via ICON.

AI Use in This Course

You are welcome to use AI tools as a learning aid, especially to:

- Clarify microfabrication concepts and terminology
- Learn about standard process options, materials, and trade-offs
- Explore alternative fabrication flows or process sequences at a high level

However, AI tools can hallucinate or produce incomplete or incorrect information. Any proposed process flows, steps, or techniques must be independently verified, and references should be checked as real and reliable.

Because the final exam is closed book and evaluates your independent reasoning, relying on AI to solve or substantially structure homework problems will directly hurt your exam performance, even if such use is not detectable. Developing your own analytical judgment is essential for becoming an expert rather than relying on automated tools.

Documentation

If AI is used to understand concepts or explore process options for a homework or lab assignment, briefly note how it was used (e.g., “used AI to review common etch chemistries for GaN”).

AI tools are not valid sources to cite. Citations should be to textbooks, review articles, or peer-reviewed publications.

Not Permitted

Having AI derive, compute, or write solutions to assigned problems

Asking AI to “solve,” “set up,” or “check” homework answers

When in doubt, ask the instructor. If you are uncertain whether a particular use is appropriate, assume it is not permitted until clarified.

Exams: The final exam date will be announced when known

Grading: Problem Homeworks 40%; Lab Homeworks: 40%; and Final 20%

Communication: UI Email

Students are responsible for all official correspondences sent to their UI email address (uiowa.edu) and must use this address for any communication with instructors or staff in the UI community.

Drop Deadline for this Course

You may drop an individual course before the drop deadline; after this deadline you will need collegiate approval. You can look up the drop deadline for this course here**.** When you drop a course, a “W” will appear on your transcript. The mark of “W” is a neutral mark that does not affect your GPA. To discuss how dropping (or staying in) a course might affect your academic goals, please contact your Academic Advisor. Directions for adding or dropping a course and other registration changes can be found on the Registrar’s website**.** Undergraduate students can find policies on dropping CLAS courses here**.** Graduate students should adhere to the academic deadlines and policies set by the Graduate College.

Academic Honesty and Misconduct

All students in CLAS courses are expected to abide by the CLAS Code of Academic Honesty. Undergraduate academic misconduct must be reported by instructors to CLAS according to these procedures. Graduate academic misconduct must be reported to the Graduate College according to the Graduate College Manual.

Student Complaints

Students with a complaint about a grade or a related matter should first discuss the situation with the instructor, and finally with the Director or Chair of the school, department, or program offering the course.

Undergraduate students should contact CLAS Undergraduate Programs for support when the matter is not resolved at the previous level. Graduate students should contact the CLAS Dean's Office when additional support is needed.

Tentative Schedule

Schedule	Theme	References	Assignments / exams
Week 1 (Jan 15)	A Review of Materials Science	Ohring Ch 1	
Week 2 (Jan 19)	Vacuum Science and Technology	Ohring Ch 2	Problem Homework 1 due
Week 3 (Jan 26)	Introduction to Photolithography	• Introductory MEMS Ch 3 and 4 • Campbell: Ch 7 and 8	
Week 4 (Feb 2)	Lab 1: Tu: Mask design and Th: Process flow		
Week 5 (Feb 9)	Thin Film Evaporation	Ohring Ch 3	Lab Homework 1 due
Week 6 (Feb 16)	Lab 2: Spinning		Problem Homework 2 due
Week 7 (Feb 23)	Plasma Physics, Chemistry, Sputtering, Etching	Ohring Ch 4 Campbell Ch 10	Lab Homework 2 due
Week 8 (Mar 2)	Tu: Review day Th: Plasma cont.	Ohring Ch 5 Campbell Ch 11	
Week 9 (Mar 9)	Lab 3: Photolithography		
Week 10 (Mar 23)	Chemical Vapor Deposition / Epitaxy	Ohring Ch 6-8	Lab Homework 3 due
Week 11 (Mar 30)	Lab 4: E-beam Evaporation and Liftoff		Problem Homework 3 due
Week 12 (Apr 6)	Film Structure and Characterization Film Adhesion and Mechanical Integrity	Ohring Ch 9-10 Ohring Ch 11-12	
Week 13 (Apr 13)	Tu: Films cont. Th: Review day		Lab Homework 4 due
Week 14 (Apr 20)	Lab 5: Etching		Homework 4 due
Week 15 (Apr 27)	Electron-Beam Lithography and Nanoscale Patterning	Campbell Ch 9	Lab Homework 5 due

University Policies

University policies

Accommodations for Students with Disabilities
The University is committed to providing an educational experience that is accessible to all students. If a student has a diagnosed disability or other disabling condition that may impact the student's ability to complete the course requirements as stated in the syllabus, the student may seek accommodations through Student Disability Services (SDS). SDS is responsible for making Letters of Accommodation (LOA) available to the student. **The student must provide an LOA to the instructor as early in the semester as possible, but requests not made at least two weeks prior to the scheduled activity for which an accommodation is sought may not be accommodated.** The LOA will specify what reasonable course accommodations the student is eligible for and those the instructor should provide.

Free Speech and Expression
Absences for Religious Holy Days
Non-discrimination
Classroom Expectations
Sexual Harassment/Misconduct and Supportive Measures
Conflict Resolution
Mental Health
Basic Needs and Student Support
Sharing of Class Recordings
Absences from Class
Absences for Military Service Obligation