

Spring 2020

Thin Film Materials (PHYS: 7905)

Instructor: John Prineas, Professor

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Office hours: Mon 10:30 to 1:30 pm (Or by appointment)

Department: Department of Physics and Astronomy

Department Office is in 203 Van Allen

Department Executive Officer is Professor Fred Skiff

available for appointment via Heather Mineart, 203 Van Allen, 335-1688

Course location & times: Van Allen 358, TuTh 9:30 - 10:45 am

Course website: icon.uiowa.edu

Course description: Thin films play an important role in many technological applications, including micro- and opto-electronics, and optical and surface coatings, and are the foundation of micro- and nano-fabrication of materials. This course will provide an introduction to growth and properties of thin film materials. We will examine modes and techniques of growth and deposition of films, including evaporation, plasma interactions, sputtering, chemical vapor deposition, and epitaxy; film structure, defects, nucleation, and characterization; film interdiffusion, reactions, and transport; film stability, stress, relaxation, and properties.

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

Text: Materials Science of Thin Films, Milton Ohring (2002)

Other references: Multiple; will be posted to website

Format: Two lectures will be given a week. Problem sets will be assigned every three weeks. One midterm and a final exam will be given.

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

Exams: A midterm is tentatively scheduled for Tu Mar 10. The final exam date will be announced when known.

Grading: Class Participation: 10% Homework 30%; Midterm 30%; and Final 30%.

Absences and Attendance Students are responsible for attending class and for contributing to the learning environment of a course. Students are also responsible for knowing their course

absence policies, which will vary by instructor. All absence policies, however, must uphold the UI policy related to student illness, mandatory religious obligations, including Holy Day obligations, unavoidable circumstances, or University authorized activities (<https://clas.uiowa.edu/students/handbook/attendance-absences>). Students may use this absence form to aid communication; the instructor will decide if the absence is excused or unexcused (<https://clas.uiowa.edu/sites/default/files/ABSENCE%20EXPLANATION%20FORM2019.pdf>).

Academic Integrity All students enrolled in courses offered by CLAS have, in essence, agreed to the College's Code of Academic Honesty. Misconduct is reported to the College, resulting in suspension or other sanctions, with sanctions communicated with the student through the UI email address (<https://clas.uiowa.edu/students/handbook/academic-fraud-honor-code>).

Accommodations for Disabilities UI is committed to an educational experience that is accessible to all students. A student may request academic accommodations for a disability (such as mental health, attention, learning, vision, and physical or health-related condition) by registering with Student Disability Services (SDS). The student is then responsible for discussing specific accommodations with the instructor. More information is at <https://sds.studentlife.uiowa.edu/>.

Administrative Home of the Course The College of Liberal Arts and Sciences (CLAS) is the administrative home of this course and governs its add/drop deadlines, the second-grade-only option, and related policies. Other colleges may have different policies. CLAS policies may be found here: <https://clas.uiowa.edu/students/handbook>.

Communication and the Required Use of UI Email Students are responsible for official correspondences sent to the UI email address (uiowa.edu) and must use this address for all communication within UI (Operations Manual, III.15.2).

Complaints Students with a complaint about an academic issue should first visit with the instructor or course supervisor and then with the Chair of the department or program offering the course; students may next bring the issue to the College of Liberal Arts and Sciences. For more information, see <https://clas.uiowa.edu/students/handbook/student-rights-responsibilities>.

Final Examination Policies The final exam schedule is announced around the fifth week of classes; students are responsible for knowing the date, time, and place of a final exam. Students should not make travel plans until knowing this information. No exams of any kind are

allowed the week before finals. Visit <https://registrar.uiowa.edu/final-examination-scheduling-policies>.

Nondiscrimination in the Classroom UI is committed to making the classroom a respectful and inclusive space for all people irrespective of their gender, sexual, racial, religious or other identities. Toward this goal, students are invited to optionally share their preferred names and pronouns with their instructors and classmates. The University of Iowa prohibits discrimination and harassment against individuals on the basis of race, class, gender, sexual orientation, national origin, and other identity categories set forth in the University's Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity (diversity.uiowa.edu).

Sexual Harassment Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community must uphold the UI mission and contribute to a safe environment that enhances learning. Incidents of sexual harassment must be reported immediately. For assistance, please see <https://osmrc.uiowa.edu/>.

Tentative Schedule

Week 1 (Jan 20): Chapter 1: A Review of Materials Science

Week 2 (Jan 27): Chapter 1: A Review of Materials Science

Week 3 (Feb 3): Chapter 1: A Review of Materials Science

Week 4 (Feb 10): Chapter 2: Vacuum Science and Technology; Chapter 3: Thin Film Evaporation Processes

Week 5 (Feb 17): Chapter 3: Thin Film Evaporation Processes; Chapter 4: Discharges, Plasmas, and Ion-Surface Interactions

Week 6 (Feb 24): Chapter 4: Discharges, Plasmas, and Ion-Surface Interactions; Chapter 5: Plasmas and Ion-Beam Processing of Thin Films

Week 7 (Mar 2): Chapter 5: Plasmas and Ion-Beam Processing of Thin Films; Review

Week 8 (Mar 9): Exam; Chapter 6: Chemical Vapor Deposition

Spring Break (Mar 16)

Week 9 (Mar 23): Chapter 6: Chemical Vapor Deposition; Chapter 7: Substrate Surfaces and Thin Film Nucleation

Week 10 (Mar 30): Chapter 7: Substrate Surfaces and Thin Film Nucleation; Chapter 8: Epitaxy

Week 11 (Apr 6): Chapter 8: Epitaxy

Week 12 (Apr 13): Chapter 9: Film Structure; Chapter 11: Interdiffusion, Reactions, and Transformations in Thin Films

Week 13 (Apr 20): Chapter 11: Interdiffusion, Reactions, and Transformations in Thin Films

Week 14 (Apr 27): Chapter 12: Mechanical Properties of Thin Films

Week 15 (May 4): Chapter 12: Mechanical Properties of Thin Films; Review