

PHYS5324: Thin Films Laboratory/MSEC7310: Nanoscale systems and devices, Spring 2015

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E-mail: es39@txstate.edu

Course Information

- **Class meetings: Mon 9:30 – 10:50 RFM 3219**
- **Necessary background knowledge:** Physics: Understanding of introductory physics, waves and Maxwell's equations, modern physics with quantum treatment, thermal and statistical physics. Mathematics: Advanced working knowledge through calculus and differential equations. Materials Science: basic knowledge of materials engineering, synthesis, processing and characterization. Chemistry: A basic knowledge of chemical protocols, procedures, and adherence to safety standards is necessary for this course. Computer skills: An ability to program numerical algorithms in MATLAB (or similar high-level language) and display results in graphical form.

Course Description

- **Overview:** This course is designed as hands on real-life experimental research experience with emphasis on nanoscale device fabrication. The course provides a strong background in devices with applications in nanoelectronics, photonics, micro- and nanoscale manipulation. Students are expected to form small research groups (3-4 people) to work as a team on research topics provided by Course Instructor. All research project will be carried at Nanofabrication Research Shared Space (Cleanroom) (<http://www.msec.txstate.edu/Research-Programs/Nanofabrication.html>) and Analysis Research Service Center (RSC) (<http://www.msec.txstate.edu/Research-Programs/Analysis.html>) with state-of-the-art thin film growth, processing and characterization user facilities capabilities. Following this course, students are expected to have a working knowledge of nanofabrication processing and characterization methods and demonstrated ability to apply this methods to research problems. MSEC, PhD students should expect additional load of more advanced research topics such as working photovoltaics, thin film transistors, LEDs, MBE and MOCVD.
- Tentative research topics:
 1. E-beam deposition of high quality, ultra-flat gold films on Si substrates.
 2. Sputtered $\text{Ni}_x\text{Fe}_y\text{O}$ permalloy oxide films for non-volatile memory applications
 3. Thermally grown SiO_2 film for MOS capacitor application.
 4. TBA
- **Grading components:** Course grading components are research proposal, presentations (Group Reports) and final poster session.
- **Anyone who does not adhere to safety standards in the laboratory, fails to observe cleanroom rules and protocols of the facility, disregards instruction, or who engages in any kind of horseplay will automatically fail the course.**
- **Grading scale:** A=100-85%, B=84-75%, C=74-65% and D=64-50%, F=49 to 0%.

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- **Textbooks:** 1. "Introduction to Physics and Technology of Thin Films" by Yuming Wang and Alfred Wagendristel, World Scientific Pub Co. 1994.
- 2. "Handbook of Thin Film Deposition (3rd Edition) by Seshan, Krishna, William Andrew, 2012
- 3. "Fundamentals of Nanoscale Thin Film Analysis" by Alford, Terry L. Feldman, Leonard C. Mayer, James W., Springer, 2007.

You do not need to purchase those text, they are available to you through the Alkek Library.

<http://site.ebrary.com/lib/txstate/reader.action?docID=10700664>

<http://site.ebrary.com/lib/txstate/reader.action?docID=10578531>

<http://site.ebrary.com/lib/txstate/reader.action?docID=10229136>

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Tentative Course Schedule with Tentative Content

Month	Week	Workshop	Laboratory
January			
	KW3	Introduction to thin film science	Online Safety Training
	KW4	Competitive research proposal writing	Introduction to Safety and Cleanroom Practices + Facility Walkthrough
February	KW1	Vacuum Technology	Vacuum Controllers, Hardware, and System Operation Furnace
	KW2	Thin Film Metrology	Thermal and e-beam vacuum deposition
	KW3	Proposal submission and review	(Thermal) Oxidation of Silicon
	KW4	Group report. Physical Vapor Deposition	RF Sputtering
March	KW1	Group report. RF Sputtering	Scanning Electron Microscopy
	KW2	Group report. Thermal Processing	Scanning Electron Microscopy/EDX
	KW3	Group report. SEM	Atomic Force Microscopy
	KW4	Group report. AFM	Atomic Force Microscopy
April	KW1	Group report. X-Ray analysis	XRD/XRR
	KW2	Group report. TBA	XRD/XRR
	KW3	Group report. TBA	Impedance spectroscopy
	KW4	Group report. TBA	TBA
			TBA
May	05/11	Final Exam/Poster Session (3:00-5:30 PM)	

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TEXAS STATE UNIVERSITY POLICIES:

You are expected to know Texas State's rules concerning Academic Honesty. You can get information on Academic Honesty from the Dean of Students Office or your instructor or your copy of the Texan State student handbook. Academic dishonesty will not be tolerated and will be treated according to the university honor code.

Texas State Academic Honor Code

As members of a community dedicated to learning, inquiry and creation, the students, faculty and administration of our university live by the principles in this Honor Code. These principles require all members of this community to be conscientious, respectful and honest.

WE ARE CONSCIENTIOUS. We complete our work on time and make every effort to do it right. We come to class and meetings prepared and are willing to demonstrate it. We hold ourselves to doing what is required, embrace rigor, and shun mediocrity, special requests, and excuses.

WE ARE RESPECTFUL. We act civilly toward one another and we cooperate with each other. We will strive to create an environment in which people respect and listen to one another, speaking when appropriate, and permitting other people to participate and express their views.

WE ARE HONEST. We do our own work and are honest with one another in all matters. We understand how various acts of dishonesty, like plagiarizing, falsifying data, and giving or receiving assistance to which one is not entitled, conflict as much with academic achievement as with the values of honesty and integrity.

E-mail Communication

All e-mail communications for this course, no matter who are the participants in the exchange, should be professional. Do not use text message abbreviations and other shortcuts. Write in complete sentences and use only jargon specific to the course.

Put your course number (**PHYS 5324**) in the subject line along with a description of the content. Putting the course number in the subject allows your instructor to respond to you in a timely manner.

A Texas State email address is a course requirement. If you send to the instructor you must use your Texas State email address, for example, zzz99@txstate.edu. This is University policy. Messages from other email services will not be read. If you are not at a University computer, emails can be sent via Texas State Bobcat Mail (go to www.txstate.edu and select bobcatmail).

University policy discourages sending grade information via email. Use office hours to discuss grading and to go over exams.

Special Needs

Students with special needs (as documented by the Office of Disability Services) should identify themselves at the beginning of the semester. Students with special testing accommodations will take their tests at Disability Services in the LBJ Center. Please see the instructor at least a few days before the test to make sure everything is in order and that a test will be available for you. Disability Services requires that signed forms be presented to them at least two business days before the test is scheduled.