

Advanced Semiconductor Nanotechnology: from epitaxy to device applications

EE 396V (16898)

Instructor:

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Class time: MW 1030am - noon

Classroom: EER 1.516

Office Hours: Immediately after class or by appointment.

Description:

EE 396V: Lectures are designed to cover current topics of semiconductor nanotechnology from crystal growth, fabrication, characterization to device applications. Semiconductor epitaxial stacks, quantum dots, nanowires, nanomembranes, and related photonic and electronic device science and technology will be discussed, with emphasis on compound semiconductors. A few guest lectures from industry will be scheduled.

This course also counts toward the Graduate Portfolio in Nanomanufacturing (<https://nascent.utexas.edu/nanomanufacturing-portfolio-program>).

Prerequisites:

EE 339 Solid State Electron Devices or equivalent; or consent of instructor.

Tentative Lecture Topics

1. Overview of semiconductor nanotechnology
2. Formation of semiconductor nanotechnology building blocks:
 - Bottom-up: epitaxial growth (MOCVD and MBE) of dots, wires, and membranes
 - Top-down: lithography and etching
3. Characterization of nanotechnology building blocks
4. Nanotechnology inspired device advancement
 - emitters and detectors
 - 3D transistors
 - multijunction tandem solar cells
 - nanowire thermoelectrics
 - chemical and biological sensing
5. Integration and manufacturing

Textbooks

Required Text: none (references will be cited during lectures)

Supplementary references:

- Epitaxy of nanostructures, By Shchukin, Ledentsov, Bimberg, Springer, 2004
- Metalorganic Vapor Phase Epitaxy (MOVPE): Growth, Materials Properties, and Applications, Stuart Irvine, Peter Capper, John Wiley & Sons Ltd. 2020.
DOI:10.1002/9781119313021
- Semiconductor Nanostructures for Optoelectronic Applications, Steiner, Artech House, 2004
- Future Trends in Microelectronics, Luryi, Xu, Zaslavsky, John Wiley & Sons, 2007

Grading

Homework	20%
Mid-term project*	30%
Final project**	40% (see notes below)
In class participation	10%

*The mid-term project is a literature review report.

**The final project is a research proposal in a format similar to that of the National Science Foundation. It requires students (2 – 4 students for each proposal) to review literature, write and present full length research proposals (12 - 15 pages) that define the state of the art, propose innovative ideas relevant to semiconductor nanotechnology to advance the state of the art, and lay out detailed plans of execution (assuming sufficient facility availability but realistic timelines). This is essentially a whole semester effort of a scientific discovery and research innovation process, with a perspective on technology. Note that 10% of the final project credit is for team formation and proposal outline, due 3 weeks before the final week.

Add/Drop Policy

Graduate ECE students have the first 12 days of the semester to add and drop graduate ECE courses. Dropping a course after the 12th day of the semester must be approved by the Graduate ECE advisor and Dean of the Graduate school, among others.

Academic Honesty

Discussion of homework questions is encouraged. However, please submit your own independent homework solutions. Plagiarism of any form of academic misconduct (including but not limited to, copying another student's work, copying material directly from a book, article or web site without proper acknowledgement, falsifying data, doing someone else's work) is a violation of University rules and will result in disciplinary actions.

Students with Disabilities

The University of Texas at Austin provides upon request appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean Students at 471-6259, 471-4241, TDD, or the College of Engineering Director of Students with disabilities at 471-4382

Counseling and Mental Health

Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support.

<http://www.cmhc.utexas.edu/individualcounseling.html>

Title IX Reporting

Title IX is a federal law that protects against sex and gender-based discrimination, sexual harassment, sexual assault, sexual misconduct, dating/domestic violence and stalking at federally funded educational institutions. UT Austin is committed to fostering a learning and working environment free from discrimination in all its forms where all students, faculty, and staff can learn, work, and thrive. When sexual misconduct occurs in our community, the university can: Intervene to prevent harmful behavior from continuing or escalating.

- Provide support and remedies to students and employees who have experienced harm or have become involved in a Title IX investigation.
- Investigate and discipline violations of the university's relevant policies.

Faculty members and certain staff members are considered "Responsible Employees" or

"Mandatory Reporters," which means that they are required to report violations of Title IX to the Title IX Coordinator at UT Austin. I am a Responsible Employee and must report any Title IX related incidents that are disclosed in writing, discussion, or one-on-one. Before talking with me, or with any faculty or staff member about a Title IX related incident, be sure to ask whether they are a responsible employee. If you want to speak with someone for support or remedies without making an official report to the university, email advocate@austin.utexas.edu. For more info about reporting options and resources, visit <https://titleix.utexas.edu/campus-resources> or contact the Title IX Office at titleix@austin.utexas.edu.