MATSCEN 5552 (Approved): Nanoscale Synthesis and Processing of Electronic Materials

Course Description

Processing, structure and stability of materials in micro(nano)electronics. Thin film epitaxy, semiconductor heterostructures, quantum confinement, bandgap engineering, electronic properties of defects, nanolithography, self-assembled nano-structures

Prior Course Number: MSE676
Transcript Abbreviation: Nano Elec. Matl.
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad, Graduate
Student Ranks: Junior, Senior, Masters, Doctoral
Course Offerings:
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: MSE3271 and MSE3141, or permission of instructor.
Exclusions:
Cross-Listings:

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1801
Subsidy Level: Baccalaureate Course

Programs

Abbreviation	Description
MATSCEN	Materials Science and Engineering

Course Goals

To introduce students to the processing, structure and stability of materials in micro(nano)electronics. Students will learn the technology involved in silicon processing, design of process flow, engineering aspects of nano-micro-fabrication.
To introduce students to thin film epitaxy and semiconductor heterostructures engineering.
To introduce students to quantum confinement and bandgap engineering in modern electronic and optical materials.
To introduce students to the electronic properties of defects, nanolithography techniques, and self-assembled nano-structures.

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Introduction and Review: Materials in electronic devices; their role/function in the devices; overview electronic materials.	1.5							
Crystal Growth and Defects [electronic properties of defects]	4.5							
Nanolithography and Etching [photolithography and nanolithography: e-beam, dip pen]	3.0							
Thermal Oxidation	3.0							
Solid-State Diffusion	3.0							
Metallization and Solid-Solid Reactions	3.0							
Ion Implantation & Ion-Solid Interactions	3.0							
Device Packaging & Yield; process integration	3.0							
Materials for non-Si devices vs. Si-based devices	3.0							
Band gap engineering in compound semiconductors and oxides	3.0							
Introduction to heterostructures: electronic properties at solid-solid interfaces, quantum confinement effects for nanoelectronics and photonics.	3.0							
Thin film epitaxy: alloying, lattice matching, strain accommodation, strain relaxation in heterostructures. Misfit and threading dislocations	3.0							
Self-assembled nanostructures: nanowires, quantum dots.	3.0							
Final design project	3.0							

Representative Assignments

Final design project example: Use process and device simulation software to optimize a device structure. Specific example: Optimize dopant/annealing to simultaneously minimize junction depth and sheet resistance.

Grades

Aspect	Percent
Weekly quizzes	25%
Mid-term Exams (or Homework)	30%
Student presentation on modern processing topics	20%
Final Design Project	25%

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
***	a	An ability to apply knowledge of mathematics, science, and engineering.
***	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
***	c	An ability to design a system, component, or process to meet desired needs.
***	d	An ability to function on multi-disciplinary teams.
***	e	An ability to identify, formulate, and solve engineering problems.
	f	An understanding of professional and ethical responsibility.

Course Contribution		**College Outcome**
	g	An ability to communicate effectively.
	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
	i	A recognition of the need for, and an ability to engage in life-long learning.
	j	A knowledge of contemporary issues.
	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

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