THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Epitaxial Heterostructures

ECE 7531

Credit Hours:
2.00 - 2.00

Course Levels:
Graduate (5000-8000 level)

Course Components:
Lecture

Course Description:
Science and techniques behind thin film growth and engineering for combining different materials, altering chemical composition at the nanometer scale, while controlling defects and strain. Epitaxial crystal growth will be explained. Students will gain an understanding of the kinetics, thermodynamics, and technology involved in epitaxial heterostructures and self-assembled nanostructures.

Prerequisites and Co-requisites:
Prereq: Grad standing.

Course Goals / Objectives:
- Develop a technical knowledge of vacuum science
- Develop a working knowledge of thin film characterization techniques
- Students will gain an understanding of kinetics and thermodynamics of thin film / epitaxial growth
- Introduce students to advanced impurity doping techniques and limits therein
- Students will gain a working knowledge of advanced electronic and optical design tools especially quantum confined and nanostructures.
- Students will demonstrate analytical ability in reviewing case studies from scientific literature on the topic of epitaxial heterostructures.

Course Topics:

- Intro to Vacuum science: pumps, gauges, mean free path, baking
- Standard epitaxial characterization: RHEED, HRXRD, AFM
- Thin film kinetics versus thermodynamics
- Comparing growth methods (MBE versus MOCVD, sputtering, PLD)
- Adatom mobility, sticking coefficient, surface diffusion
- Growth modes: Volmer-Weber, Stranski-Krastinow, Frank–van der Merwe
- Misfit, threading dislocations, strain relaxation (critical thickness)
- Impurity doping: techniques, calibration, uniformity, incorporation during growth, diffusion, amphotericity and autocompensation
- Advanced electronic/optical design tools: quantum wells, modulation doping, polarization doping
- Digital superlattices, DBRs, multi quantum wells
- Self-assembled nanostructures: quantum dots, nanowires
- Case studies: Limited solubility and metastable phases, GaMnAs
- Case studies: Epitaxy of dissimilar materials, ErAs/GaAs
- Case studies: nanowire heterostructures, strain accommodation

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Designation:
Elective