IN224 Jan 3:0

Nanoscience and Device fabrication

Instructor

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Department: Instrumentation and Applied Physics

Course Time: Monday,Thursday 10:00-11:30 am.

Lecture venue:

Detailed Course Page:

Announcements

Brief description of the course

This course will be about the fundamental concepts of nano structured materials.

First the course will start with the introduction to classical particles, classical waves, quantum particles, wavefunction, schrodinger equation and standing waves.

Problems which led to origin of quantum mechanics will be discussed.

Why understanding of quantum mechanics is important to understand nanostructured materials. Quantum mechanics or electrons. Free and confined electrons. Electrons subject to a periodic potential-Band theory of solids.

What are nanomaterials. Classification of nanomaterials.

Solution of scrodinger equations for 1D, 2D, 3D nanostructures.

Understanding Band structure, density of states, for 1D, 2D, 3D confined nanostructures. Models for Semiconductor Quantum wells, quantim wires and quantum dots.

Structural, optical, electronic properties of nanomaterials

Growth and fabrication of nanomaterials. Thermodynamics of nanostructure growth: concept of Nucleation and growth.

Characterization techniques like FIB, TEM, XRD, Photoluminesence etc.

Prerequisites

None

Syllabus

Nanoscience: Introduction, classification, Summary of electronic properties of atoms and solids, Effects of the nanometer length scale, General methodologies for nanomaterial characterization, semiconductor physics - semiconductor nanostructures, Quantum confinement in semiconductor nanostructures, Modulation doping, Interband/Intraband absorption in semiconductor nanostructures, Phonon bottleneck, thermodynamics and kinetics of phase transformations, Applications of semiconductor nanostructures

Device fabrication: Growth techniques and properties,

thin film phenomena, PVD and CVD techniques, MBE-growth of self assembled InAs quantum dots,

Heterostructures grown inside MBE, FIB for ion implantation and insulation writing, lithography.

Course outcomes

After taking this course a student will be able to understand

1. Role of quantum mechanics in Nanomaterials

2. Band structure of nanomaterials

3. structural, optical, electronic properties of nanomaterials

4. How to analyse data from characterization techniques like XRD, TEM, Absorption and emission spectroscopy.

Grading policy

20 % assignments

30 % mid term

50 % Final term

Assignments

Resources

Introduction to nanoelectronics by V.V.Mitin, V.A.Kochelap, M.A.Stroscio

Fundamentals of nanoelectronics By George W. Hanson

Nanoscale Science and Technology By R.W.Kelsall, I.W.Hamley, M.Geoghegan