PH504 Organic Optoelectronics

Credit: (3-0-0-3) Approval: Approved in 2nd Senate

Prerequisites: Mechanics of Particles and Waves & Electrodynamics

Students intended for: B.Tech

Elective or Core: Elective Semester: Odd/Even

Course objective:

This course will help to acquire knowledge in the field of organic electronics and optoelectronics: basic theory, applications, recent developments, etc. It will help to study and understand scientific literature in this field by knowing relevant terminology. The course contains an overview of organic electronic and optoelectronic devices. Various relevant phenomena of organic materials and their applications in light emitting devices, solar cells and thin film transistors, etc. are discussed. Aspects related to device fabrication may also be addressed.

Course content:

PART I.

- Organic Molecules: Electronic structure of atoms, Atomic and Molecular Orbitals, LCAO, Bonding and antibondig orbitals, Covalent Bond, Sigma and Pi Bonds, Energy Levels, Spectroscopic properties [4 Lectures]
- Photophysics of Molecules and Aggregates: Excited states: Absorption and emission, Singlet and triplet states, Radiative and non-radiative transitions, Aggregates, Van der Waals Bonding, Hydrogen Bonding, Dimer, Eximers. [2 Lectures]
- Excitons: Wannier Exciton, Charge-transfer Exciton Frenkel Exciton, Exciton Diffusion, Excitonic Energy Transfer. [2 Lectures]
- Conduction in Organic Solids: Conductivity: carrier concentration versus mobility, Carrier generation, Hopping transport, Mobility measurements, Traps. [2 Lectures]
- Photovoltaics and Photodetectors: Photovoltaic Devices: Organic Heterojunction Photovoltaic Cells, Organic/Nanorod hybrid Photovoltaics, Gratzel Cells (Dye sensitized solar cells),Photodetector Devices [5 Lectures]
- Organic Light Emitting Devices: Basic OLED Properties, Charged Carrier Transport, Organic LEDs, Quantum Dot LEDs. [8 Lectures]
- Lasing Action in Organic Semiconductors: Lasing Process, Optically Pumped Organic Lasers, Electrical Pumping of Organic Lasers. [2 Lectures]
- Organic Thin Film Transistors: OFETs: Materials, Contacts, Applications, Nanotube Transistors. [2 Lectures]
- Device Fabrication Technology: Growth Techniques: Evaporation, Langmuir-Blodget, Chemical Vapor Phase Deposition, Ink-Jet Printing, Self Assembly. [3 Lectures]

PART II.

- Project: Literature review on a certain relevant topic. [10 Lectures]

TEXTBOOK:

No textbook required. Lecture notes and handouts will be provided.

GENERAL REFERNCES

1. “Essentials of Molecular Photochemistry”, Gilbert &Baggott, CRC Press, 1991.

2. “Fundamentals of Photochemistry” K. K. Rohatgi-Mukherjee, NewAge International, 1978.

3. “Electronic Processes of Organic Crystals and Polymers” , Pope &Swenberg, Oxford University press, 2nd edition (1999).

4. “Organic Semiconductors” H. Meier, VerlagChemie GmbH, 1974

5. “Physics of Organic Semiconductors” Wolfgang Brütting, John Wiley & Sons Canada; 1 edition (2005)

6. “Organic Electronics: Materials, Manufacturing, and Applications”, Hagen Klauk, John Wiley & Sons; 1st edition (2006)

7. “Electrical transport in solids: with particular reference to organic semiconductors”, Kao, Pergamon Press; 1st edition (1981).