Course Outline

Proposed course name: Optical Properties of Solid-State Materials
Course number: CHEM 9546T
Planned: Winter 2020

Instructor: Lijia Liu
Email & tel: ljliu@suda.edu.cn (temporary)
Schedule: TBD

Course Description:
This quarter course focuses on the phenomenon of light interaction with solids. It covers several core topics on the optical properties of materials. It provides a fundamental understanding on how luminescence (usually at visible region) is generated when a material is excited by an external source. Several representative solid-state material systems will be discussed, such as semiconductors, molecules, semiconductor with color centers, nanomaterials with quantum confinement, and metal nanoparticles. Practical experimental techniques on optical spectroscopy measurements, such as UV-visible absorption spectroscopy, fluorescence spectroscopy, and lifetime measurements will also be introduced.

Topics:
Tentative topics and schedule are the following:
• Introduction
  ◦ Optical processes
  ◦ Core concepts in optical physics
• Fundamentals
  ◦ Absorption processes
  ◦ Excitons
  ◦ Emission processes, luminescence
• Examples
  ◦ Semiconductors
  ◦ Quantum confinement and quantum dots
  ◦ Molecular materials
  ◦ Color centers
  ◦ Metal nanoparticles
• Instrumental and data analysis
  ◦ Steady-state measurements
  ◦ Time-resolved measurements

Material:
No textbook required. 
Lecture notes and handouts will be provided as the course proceeds.
Prerequisites:
Basic knowledge of solid-state physics and quantum theory at an introductory level is desirable.

Evaluation:
Problem sets: 3 take-home problem sets, 60%
Written report: 40%

Learning outcome:
Upon completion of this course, students will be able to
- Understand the fundamental physical process of luminescence
- Identify the critical microscopic parameters of a material that determines its light emission property
- Predict how the luminescence of a material can be controlled or modified through chemical/material engineering
- Work from experimental optical spectroscopy data to deduce the microscopic properties of materials

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