Course title

Functional Nanostructure: Synthesis, Characterizations and Device Applications

Instructor(s)-in-charge:

Prof. HE Jun& Prof. WEI Zhixiang

Course type:

Lecture

Course Schedule:

4hrs/week by instructor. 1 hr/week by teaching assistant.

Course Assessment:

Homework: 12 assignments

Grading Policy:

Typically 40% homework, 40% each midterm, 20% final.

Course Prerequisites:

Solid state physics, semiconductor physics, general chemistry，physical chemistry

Catalog Description:

This course includes three sections: inorganic semiconductor nanostructures, organics functional nanostructure and characterization of nanomaterials. The first section provides atoms-to-device introduction to the latest semiconductor quantum heterostructures. It covers nanostructures growth, their electronic, optical, and transport properties, their role in exploring new physical phenomena, and their utilization in devices. For the second part, by studying of this section, student should know the history and principles of organic electronics, understand how to use various strategies to produce organic functional nanomaterials, get the ideas how to construct organic electronic and optoelectronic devices, including filed effect transistors, light emitting diodes, and photovoltaics. The third provides Electron microscopic characterization of nanomaterials, Spectroscopic characterization of nanomaterials and some latest applications of nanomaterials.

Schedule of the course

section	content	hours	Date
1	Basic of Low dimensional-semiconductors	8	September 13 September 20
2	Low dimensional semiconductors growth	8	September 27 October 11
3	Low dimensional semiconductor: device applications	8	October 18 October 25
4	Student presentation	4	November 1
5	Histories and principles of organic electronics	4	November 8
6	Preparation of organic electronic nanomaterials	4	November 15
7	Properties and applications of organic functional materials	4	November 22
8	Electron microscopic characterization	4	November 29

	of nanomaterials		
9	Spectroscopic characterization of nanomaterials	4	December 6
10	Applications of nanomaterials in nanomedicine	4	December 13
11	Student presentation	4	December 20
12	Lab Tour	2	December 27
13	Exam	2	December 27
total		60	

Contents of the course

Section 1: Low dimensional semiconductors

1. History and principles organic electronics
   (1) History of modern physics
   (2) The origin of conducting and semiconductingproperties of low dimensional semiconductor
2. Growth technique of Low dimensional semiconductors
   (1) Molecul;ar beam epitaxy
   (2) Metal-organicChemicalVaporDeposition
   (3) ChemicalVaporDeposition
3. Properties and application of Low dimensional semiconductors
   (1) Opto-electronic devices
   (2) Solar and Environmental applications
   (3) Nanogenerator and others

Section 2: Organic functional materials

4. History and principles organic electronics
5. History of organic electronics
6. The origin of conducting and semiconductingproperties of organic functional materials
7. Preparation of organic functional nanomaterials
8. Self-assembly of organic functional nanomaterials
9. Fabrication method of organic electronic devices
10. Properties and application
11. organic filed effect transistors
12. organic light emitting diodes
13. organic photovoltaics

Section 3: Characterization of nanomaterials

14. Electron microscopic (EM) characterization of nanomaterials
15. Introduction to transmission electron microscopy (TEM), scanning electron microscopy (SEM), electron diffraction and related techniques
16. Examples using electron microscopy to characterize nanomaterials (such as nanowires, quantum dots, graphene, carbon nanotubes)
17. By studying of this section, student will know the principle of EM and its applications in nanomaterial characterization.

18. Spectroscopic characterization of nanomaterials
19. Introduction to FL, Raman and IR
20. Examples using FL, Raman and IR to characterize nanomaterials (such as nanowires, quantum dots, graphene, carbon nanotubes)
21. By studying of this section, student will know the principle of FL, Raman and IR and their application in nanomaterial characterization.
22. Applications of nanomaterials in biomedicine
23. Nanomaterials as imaging probes
24. Nanomaterials as drug carriers
25. By studying of this section, student will get a brief idea about broad applications of nanomaterials in nanomedicine.

Textbook and any related course material:

Low dimensional semiconductor structures: fundamental and device applications
Edited by Keith Barnham and Dimitri Vvedensky
Organic Electronics, Materials, Processing, Electronics, and Apllications
Edited by Franky So
Characterization of Materials, edited by Elton N. Kaufmann (editor-in-chief), Wiley-Interscience.
Transmission Electron Microscopy, edited by David B. Williams and C. Barry Carter, Springer.
Principles of Fluorescence Spectroscopy, third edition, edited by Joseph R. Lakowicz, Springer.
Introductory Raman Spectroscopy, second edition, edited by John R. Ferraro, Kazuo Nakamoto and Chris W. Brown, Elsevier.

Expected level of proficiency from students entering the course:

Mathematics: strong
Physics: strong
Chemistry: strong