

Electronic Biomedical Nanosensors (電子式生醫奈米感測器)

Instructor : Yu-Lin Wang/王玉麟 (ylwang@mx.nthu.edu.tw)

Course level: graduate students

Course goals: In this course, students will learn the knowledge of biological systems, important biomolecules, and biological recognition, and different electronic transducers and the incorporation of sensing elements and nano-materials for chemical or biological molecule detection. Lab practicing enhances students' hand-on experience in the sensor design, fabrication, and measurements. Finally, students will present case study or literature review by using the knowledge they have learned in this class.

Prerequisite: general chemistry and general physics

Text Book/ Reference book:

“Biochemistry”, by R. H. Garrett and C. M. Grisham, Brooks/Cole, 4th Ed. 2010 (ISBN-13: 978-0-495-11464-2; ISBN-10:0-495-11464-2)

“Semiconductor Devices-Based Sensors for Gas, Chemical, and Biomedical Applications” by Fan Ren & Stephen J. Pearton, CRC Press, 2011 (ISBN : 978-1-4398-1387-4)

“Chemical Sensors and Biosensors,” by Brian R. Eggins, John Wiley & Sons 2002.
And handouts

Course Outline

1. Introduction: Biomedical sensor architectures, types, and applications/Design concept (2/22)
2. Field-Effect Transistors (2/29)
3. Schottky diodes, Ohmic contacts, MESFETs and PN junction(3/7)
4. Lab practicing 1: MOSFET measurements(3/14)
5. FET pH sensor theory (3/21)
6. Lab practicing 2: FET pH sensor measurements (3/28)
7. Sensing elements & immobilization: Biological systems/Protein, DNA, and Enzyme (3/30)
8. FET-based chemical/biosensors theory and applications(4/11)
9. Lab practicing 3-1: Sensor fabrication, Surface immobilization (4/18)

10. Lab practicing 3-2: FET biosensor measurements (4/25)
11. Semiconductor gas sensors (5/2)
12. Electrochemical Sensors: principle, devices and applications (5/09)
13. Triboelectric and Piezoelectric sensors (Prof. Zong-Hong Lin) (5/16)
14. Special Topic Study (5/23)
15. Special Topics Study (5/30)
16. In-class presentation (6/6)
17. Final Exam (6/13) (closed-book exam)

Grading: Lab practicing & report: 30%

Final Exam: 30%

Presentation: 30%

Attendance & contribution: 10%

Office hours: make an appointment

For the presentation:

Each student is allowed to give a talk in 15 mins and the Q & A in 5 mins. The grade for the presentation will be assessed by the whole class. English is required for the presentation. Language fluency may be considered in grading. Students need to present one major paper and include a few references in the presentation. Students are required to present the topic by utilizing the knowledge they have learned in this class. The significance, organization, depth/scientific sound, clear presentation, and Q&A will be evaluated for the presentation.