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: The first goal is to learn the knowledge of biological systems, important biomolecules, and biological recognition. The second goal is to learn different electronic transducers and the incorporation of sensing elements and nano-materials for chemical or biological molecule detection. The third goal is to make a term project with laboratory practicing.

Prerequisite: general chemistry and general physics

Text Book/ Reference book:

Part I & Part II

"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)

Part III

"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

Part I: Biomedical sensors & Biological systems

1. Introduction: Biomedical sensor architectures, types, and applications; Biological system and Buffer solutions (2/26)
2. Amino acid and Proteins: structures and functions (3/5)

Part II: Chemical and biological recognition

3. Enzymes kinetics and specificity (3/12)
4. DNA structures and characteristics (3/19)
5. Antibody, Receptors, and Chemicals; Surface Immobilization and bioconjugation (3/26)
6. Midterm Exam 1 (4/2)

Part III: Transducers and Sensors

7. Semiconductor materials properties and field-effect-transistor based biosensors (4/09)
   Binding-site model and its applications (4/09)
8. Term project + Laboratory practicing: Design, fabrication, and characterization of FET-based biosensors (4/16, 4/23)
9. Semiconductor Schottky diode-based sensors and conductor-based sensors (4/30)
10. Term project + Laboratory practicing: Design, fabrication, and characterization of gas sensors (5/7, 5/14)
11. Electrochemical Sensors: principle, devices and applications (5/21)
12. Piezoelectric materials-based Sensors: Principle, devices, and applications (5/28)
13. Other type sensors (6/4)
14. Final Exam 2 (6/11)
15. Presentation and report of Term Projects (6/18)

Grading: Exam 1: 25%
Exam 2: 25%
Presentation and report of term projects: 40% (20% for presentation by the class, 20% for report by the instructor)
Attendance & contribution: 10%

Office hours: make an appointment

For the term project: Students will discuss with the instructor to decide the topic before initiate term projects, in which, students will learn how to design, fabricate and characterize sensors. In the final presentation, students need to present their works and results, to give academically professional presentations. Students need to turn in the report by the final presentation.

For the presentation:
Each group is allowed to give a talk in 25 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 will not be considered in grading. Instead, whether the speech is well organized, the topic is significant, the review is in depth, the coverage of the content is adequate, and the answers for questions are satisfied, will be considered for evaluation. However, clear expression by the speaker will help the audience to learn easily which may lead to a positive evaluation.