Interfacing Biology with Engineering at the University of Illinois

Undergraduate Research in Prof. Rashid Bashir’s Group

http://libna.mntl.illinois.edu/

Contact: esalm2@illinois.edu

The transistor sub-group in the Bashir lab is searching for motivated undergraduates to get directly involved on a transistor biosensing-based project. We are searching for 3-5 students that would each focus on one of the following areas:

1. Project Title: Biointerfacing for Assay Development on Field Effect Transistors (1 student)
   a. Goal:
      i. Develop a reproducible assay method for detecting oligonucleotides on electronic devices by:
         1. Understanding ELISA assay methodologies
         2. Optimizing surface functionalization chemistry
         3. Integrating 1 and 2 on the field effect transistor platform
   b. Requirements
      i. Basic understanding of microbiology
      ii. Basic knowledge of immunoassays like ELISA
      iii. Knowledge of organic chemistry or material’s chemistry
      iv. Able to spend +10 hours/week in lab
   c. Courses Taken (preferred)
      i. MCB 450 or 354: Biochemistry
      ii. Organic chemistry
      iii. MCB 151/251: MCB wet lab experience
   d. Suggested Majors (all may apply)
      i. Bioengineering
      ii. Chemical and Biomolecular Engineering
      iii. Materials Science

2. Project Title: Electrical Characterization of Foundry Level Transistors (1-2 students)
   a. Goal:
      i. Characterize and optimize testing of field effect transistors from one of the world’s largest semiconductor foundries by:
         1. Learning to use a Keithley Semiconductor Characterization System
         2. Performing wet and dry experiments on field effect transistors
         3. Maximizing sensor performance by optimizing the electrical measurement parameters such as drain-source bias as well as annealing conditions
   b. Requirements:
      i. Solid understanding of semiconductor theory with a focus on transistors
ii. Understanding of semiconductor processing
iii. Experience with Matlab or similar data analysis program
iv. Able to spend +10 hours/week in lab

c. Courses taken (preferred)
i. ECE 340: Semiconductor Theory
ii. ECE 444: Fabrication
iii. ECE 205/206: Circuits

d. Suggested Majors (all may apply)
i. Electrical Engineering
ii. Computer Engineering
iii. Bioengineering

3. Project Title: Biological Field Effect Transistors for Droplet-Based Nucleic Acid Amplification with Electrical Detection (1-2 students)

a. Goal:
i. Develop a technique for performing nucleic acid amplification (e.g. PCR, LAMP, RCA) on-chip and combine with electrical detection of the amplification by-products by:
   1. Optimizing surface chemistry to minimize inhibitory effects introduced by the chip’s surface and the droplet/oil interface
   2. Establishing protocol for rapid heating to minimize time required for PCR thermocycling using a previously developed AC heating technique
   3. Characterizing transistor’s stability through the heating process
   4. Performing real-time electrical detection on the FET platform

b. Requirements
   i. Prior experience in a wet lab environment
   ii. Understanding of nucleic acid amplification techniques such as PCR, LAMP, etc.
   iii. Basic understanding of transistor theory
   iv. Able to spend +10 hours/week in lab.

c. Courses taken (preferred):
i. BIOE 202: Cell and Tissue Lab
ii. ECE 205: Circuits
iii. MCB 150/250 and 151/251: Intro level Biology/Lab Courses

d. Suggested Majors (all may apply)
i. Bioengineering
ii. Chemical and Biomolecular Engineering
iii. Biophysics
iv. Electrical Engineering