Greg Wajda: Midsemester

Mentor: Yemaya Bordain
Project Description

- The project involves writing a program that controls two external lock-in amplifiers in WaveMetrics IGOR Pro technical graphing, tool automation, and data analysis software in C/C++ language. The lock-ins will interface with IGOR via GPIB-to-USB adapters. The Kelvin Probe Force Microscopy experimental, in which a dc-bias is applied between the tip and sample and lock-in amplifiers monitor the tip oscillation at frequency $1\omega$, will be modified so that external lock-ins are used instead of internal lock-ins.
Motivation/Basic Info

- It is difficult to imagine a more flexible platform for nanoscale instrumentation design than the modern atomic force microscope (AFM). The basic AFM instrument allows studies of localizing phenomena at the nanoscale using an atomically sharp tip with precise positioning control, an exquisitely sensitive scheme for measuring tiny forces using a flexible cantilever with laser deflection sensing, and a system to record and display measurements during a raster or line scan. Forces of electrical, magnetic, or chemical origin can be detected. Moreover, the tip can be used to transfer forces, fields, or matter to a sample at precise locations. We are developing a technique for sensing the dynamic behavior of semiconductor materials under depletion and inversion conditions using the force sensor of the AFM cantilever. This project involves 3-dimensional modeling of the capacitance gradients of a triple-plate capacitor system in COMSOL Multiphysics electrostatics modeling and simulation software package. The middle electrode will be parameterized so that it approaches the bottom electrode while held at a constant distance from the top electrode. The capacitance gradients will be mapped as a function of the separation distance.
What I have done so far?

• So far I have learned how to use the Lock-in amplifier with G-PIB cords connected to my laptop. I have learned how to navigate IGOR Pro and how it relates to the Lock-in amplifier. I have also started to learn some of the programming language that goes along with IGOR Pro to code the Lock-in.
Next?

• Next is to continue learning the coding language for IGOR along with C/C++. Then finally complete the project which is to modify the lock-in’s so that external lock-in’s are used instead of internal lock-in’s.