Nanoelectronics Undergraduate Research Fellowship (NURF)
2010 Project Summary

Student name: Matt Schueler
Faculty mentor name: Dr. Tao Wang
Project title: Terahertz (THz) Microfluidic Devices for Biological and Biomedical Sensing

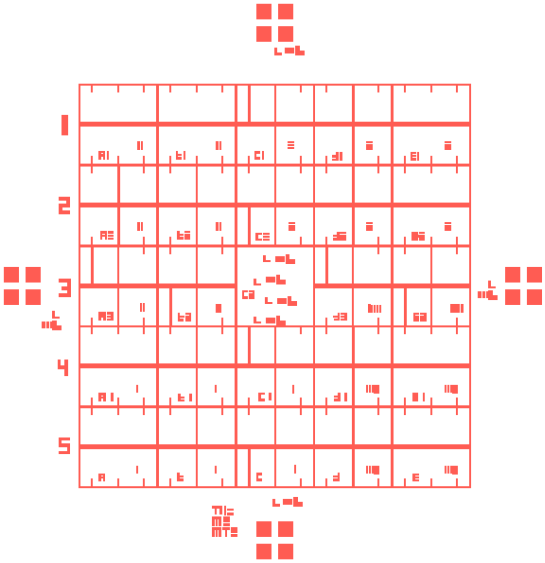
The goal of my project is to fabricate a device that utilizes terahertz frequency radiation as a source for sensing of biological molecules, combined with a microfluidic capillary for ease of processing the samples. Since many biological molecules exhibit intrinsic resonance at terahertz frequencies, such a device is ideal for studying various biochemical reactions and could eventually serve as a cheap and quick method for lab-on-a-chip diagnostics. To this end, a terahertz waveguide and cavity resonator with frequency range 165-200 GHz was designed, with a microfluidic capillary and terahertz detector included. The idea behind the design is that the biological samples can be fed through the microfluidic capillary, which runs through the cavity resonator. Based on the dielectric constant of the sample, the resonant frequency of the cavity will change. Thus, the frequency spectrum can be sensed at the output of the cavity resonator, giving information about what the sample is composed of.

My project focused on the design and fabrication of the photomasks used in the device lithography, developing a recipe for spinning, baking, and exposing the photoresists used, and implementing a Bosch recipe for etching with the DRIE machine. The photomasks were designed using L-Edit software, and the pattern was transferred to an emulsion plate using the Mann 3000 for exposure. Then the pattern was imprinted on a chrome plate (the final mask used) with the Tamarck Contact Printer. The first layer mask, which is dark with clear features, is for use with the positive photoresist AZ p4620, and the second layer mask, which is clear with dark features, is for use with the negative photoresist SU-8 2150. Using the first mask, I patterned AZ p4620 spun on a silicon wafer for use as an etchant mask before the dry etch. Then I performed a test run with the DRIE machine to determine the rate at which the silicon is being etched, and from this I can determine how long to perform the Bosch process to obtain a desired depth of 400 um. Finally, I received training for the FC 1800-2 evaporator and performed a test run depositing 10 nm of titanium and 50 nm of gold, so that when the wafer is ready I can coat the waveguide and resonator walls to increase conductivity and contain the terahertz waves. I will continue working on this project during the fall semester to finish fabricating the devices and perform tests to determine how well they compare to preliminary simulations.

The project is not finished yet, so there have been no papers or posters yet. Hopefully in the fall once the devices are finished, there will be papers or posters presenting the results.

Pictures

50 um Wall after DRIE Etch



Second Layer Photomask Design from L-Edit Software

Matt Schueler at Work on the FC 1800-2 Evaporator