ND*nano* Undergraduate Research Fellowship (NURF)
2011 Project Summary

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Project title: Photoluminescence

The goal of the project at large is to make a laser out of germanium. This would allow the limits of silicon in computer chips to be surpassed. But in order to do that, we need holes to recombine with electrons in the gamma peak so that light is emitted as opposed to heat. One of the methods to doing this is to strain germanium so that the gamma peak drops to a lower energy level than the L peak which would make the gamma peak more favorable for the electrons when they are excited. My work was mainly with germanium oxide. Germanium oxide was pursued as a means of passivation to repair and mitigate mid-gap defect states where electrons were likely to drop to instead of recombining with holes directly at the valence band. One of the problems we encountered was not knowing how different treatments of passivation on the germanium wafers would affect the relationship between the direct and indirect bandgap.

I first had to get trained in the photoluminescence set up. It was after I understood what the individual equipments did and how the measurements were being taken did I start on the samples. There were many parameters to the equipment and consistency was absolutely necessary in order to be able to make comparisons between different samples, especially measurements taken at different times. To check that the samples itself were consistent, I usually took about three measurements per sample at different locations on the wafer. From the data I collected, it seemed that varying the amount of time the samples were oxidized did not have a major effect on the peak relationships. On the other hand, increasing the oxidation temperature generated higher peak intensities but when the temperature reached about 500 degrees Celsius, it

did not seem to have much more of an effect. And in some cases, the intensities even dropped at higher temperatures. The ideal parameters for passivation seemed to be to oxidize the germanium for 30minutes to an hour at around 500 degrees C.