Nano-Flake Biosensors:

**APCVD Controlled Growth of Graphene-Boron Nitride-Graphene Nano-flakes Field Effect Transistor Biosensors**

**Introduction**
Graphene-Boron Nitride (G-BN) heterostructures allows atomically thin graphene based field effect transistors (FETs) to be utilized in biosensor technology because of their high carrier mobility at room temperature, which results from the G-BN interface being devoid of charge traps [1]. This introduction of graphene and boron nitride as the conducting and gating materials for the FET component respectively, which act as the transducer for the biosensor, has led to a need for synthetic methods that can precisely control the G-BN interface structure and avoid chemical contamination during post-growth fabrication [2]. My lab mentors and I will be using atmospheric pressure chemical vapor deposition (APCVD) to grow a single atom layer thick in-plane hexagonal heterostructure flakes of graphene-boron nitride-graphene (G-BN-G). In this way, we can research the interface structural chemistry by varying the growth parameters and construct nanoscale FETs for biosensing.

**Specific Area of Research**
The nature of my research is based on CVD growth recipes that utilize liquid or solid carbon precursors whose decomposition temperature is below 1000°C. This temperature constraint is due to prior research conducted using methane as the carbon source, which showed that at temperatures exceeding 1000°C the boron nitride ribbon will etch away completely before graphene growth[2]. Thus, I will be working with CVD growth recipes that utilize benzoic acid rather than methane as a carbon source for graphene growth because of its lower decomposition temperature compared to methane that lies beneath the 1000°C threshold.

**Approach**
The first half of the summer will involve synthesis of graphene using atmospheric pressure chemical vapor deposition from a benzoic acid source. This will involve extensive optimization
of the growth temperature and time, the carrier gases (argon and hydrogen) flow rates, and the mass of benzoic acid used. By performing these optimization experiments along with nanofabrication characterization techniques such as RAMAN and scanning electronic microscopy, it will provide a model set of CVD recipes that can be tailored towards the final synthesis of the G-BN-G heterostructure. The second half of the summer will involve biosensing experiments using protein attachment chemistries utilizing benzoic acid based graphene to see how it compares to lab samples from methane based graphene. Work on running graphene growth using benzoic acid on an already grown boron nitrate substrates will be conducted in the second half to determine a working growth temperature and etch rate in preparation for the final G-BN-G heterostructure.

Works Cited