ENSC USRA Summer 2017

Nanomaterial and Nanodevice Fabrication

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Nanomaterials have extraordinary properties not observed in bulk materials such as tunable bandgap, high carrier mobility, high surface-volume ratio, and flexibility, making them promising for new applications such as photodetectors, sensors, microelectronics, and clean energy. The student will work in the Nanodevice Fabrication Group (website: nanodevice.fas.sfu.ca) in the SFU School of Engineering Science and will be responsible for preparing and characterizing nanomaterials and devices. This project will involve working with group members and lab engineer to learn how to use lab equipment and how to prepare materials and devices.

Responsibilities will include a subset of the following, depending on time and project of interest:

- Prepare nanomaterials using cleanroom equipment.
- Characterize optical properties of nanomaterials in a photonics lab.
- Fabricate semiconductor devices incorporating nanomaterials.
- Characterize devices using a probe station.
- Design the layout for electrical contacts using CAD tools such as Cadence.

The student may work on one of the following projects:

**Project 1: Fabrication of 2D material photodetector**

2D materials such as monolayer phosphorus or MoS$_2$ have bandgaps corresponding to the visible or near infrared spectra. The bandgap of these materials can be controlled by number of atomic layers or mechanical strain. The goal of this project is to fabricate a 2D material photodetector. This project will consist of preparing 2D materials in the cleanroom, patterning the electrodes, designing electrode patterns using CAD tools, and characterizing the fabricated devices.

**Project 2: Optical characterization of tunable bandgap nanomaterials**

The bandgap of quantum confined materials are tunable (ie. their emission wavelength can be controlled) making them promising for light-emission or photodetection applications. The student will investigate the effect different factors such as applied vertical electric field, adsorption by alkali ions, or mechanical strain on bandgap of 2D materials. This project involves preparing 2D materials in the cleanroom and measuring the optical properties of these materials.

**Project 3: Fabrication of Biosensor/gas sensor**

2D materials, have very high surface-to-volume ratios making them promising for highly sensitive gas sensors. Theoretical studies have also shown that the resistance of single layer phosphorus can selectively detect gases by measuring directional changes in electrical resistance. The student will fabricate gas
sensors using a 2D material and use them to detect NO$_2$ gas which has biomedical applications such as the detection of atherosclerosis, a disease involving the hardening and narrowing of arteries.

Desirable qualifications include a strong background in electronic devices/microelectronics and previous experience working in a cleanroom or research laboratory. This is an excellent position for students interested in discovering new material properties and developing next generation of semiconductor devices. The project is also well suited for an undergraduate thesis.

Interested candidates should send their resume and cover letter to mmadachi@sfu.ca.