Boston University Photonics Center National Science Foundation Research Experiences for Undergraduates Site in Integrated Nanomanufacturing

Co-Directors: Prof. Xin Zhang and Prof. Helen Fawcett
Faculty Mentor: Scott Bunch
Introduction of Laboratory

Boston University Photonics Center Research Experiences for Undergraduates
Lab Members

• Scott Bunch – Ph.D. Physics, current - Dept. of Mechanical Engineering, Division of Materials Science and Engineering, and Dept. of Physics.

• David Lloyd – M.S. Physics (Oxford University), current – Ph.D. student, Dept. of Mechanical Engineering

• Lauren Cantley – B.S. Physics (Grinnel College) current - Ph.D. student, Dept. of Mechanical Engineering

Undergraduates: Brian (BU Student), Nicole (RISE), Magno, (Brazil), Lucas (Brazil), Ana (Brazil), Erika (Middle School Teacher)
Superior Properties

Electrical
Mechanical
Thermal

Different Bonding

Graphite

Diamond

Hope Diamond
Apollo Diamonds

Graphene/Nanotubes

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**Nanotubes**

- **Electrical**
- **Mechanical**
  - *American Scientist* 1997
- **Chemical/Biological**

**Graphene**

- **Electrical**
  - *Nature Physics* 2006
- **Mechanical**
  - *Science* 2009
- **Chemical/Biological**
  - *Nature* 2010

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2D Materials beyond Graphene

2D Materials:
Semimetal, Semiconductor, Insulator, Metals (Superconductor)

Van der Waals Heterostructures

Bu

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Why Atomic Membrane Mechanics?

Adhesion – Extremely Flexible Membrane
*vdw forces holds sheets together*
Adhesion clamps sample to substrate
Mechanics and electronics influence by substrate
Strain and flexibility dictated by adhesion

Molecular Separation
*Thin membrane*
Well defined pores
Single file molecular flux

*S. P. Koenig et al., Nature Nanotechnology, 7, 728-732 (2012)*

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Research Experiences for Undergraduates
CVD MoS$_2$

Monolayer MoS$_2$ on SiO$_2$/Si

Transferred to Wells

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Day to Day expectations for lab work

- Direct mentor will be David Lloyd. You will have day to day interactions with him. I make frequent visits to the lab and am available by email.
- We will have weekly group meetings, Wednesdays at 11am, where all the lab members present their results.
- Use PowerPoint to highlight what you did during the week and what you plan on doing the next week.