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

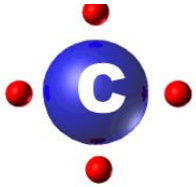
Co-Directors: Prof. Xin Zhang and Prof. Helen Fawcett
Faculty Mentor: Scott Bunch

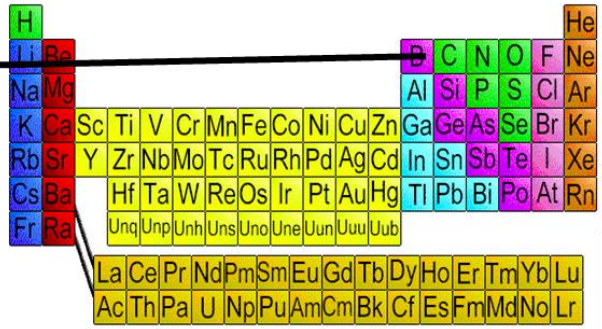
Introduction of Laboratory

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)



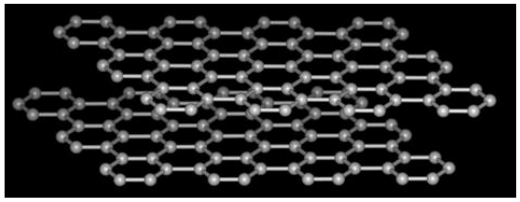


Superior Properties

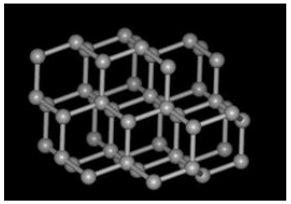
Electrical
Mechanical
Thermal

Different Bonding

Graphite



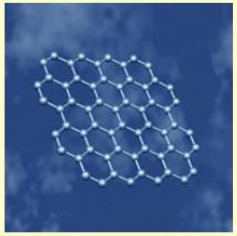
Diamond

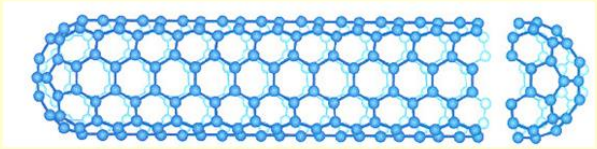


Hope Diamond

Apollo Diamonds

Graphene/Nanotubes

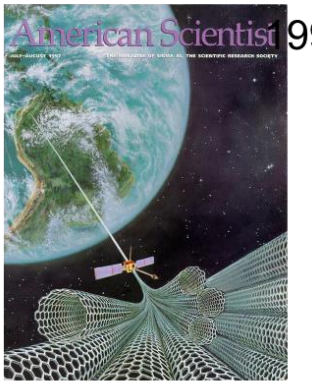




Nanotubes

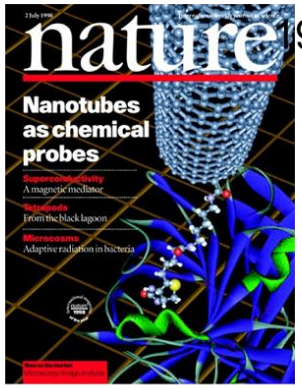
1997

Electrical



1997

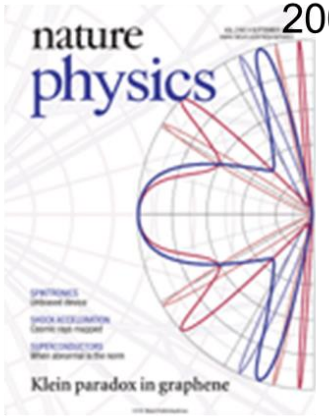
Mechanical



1998

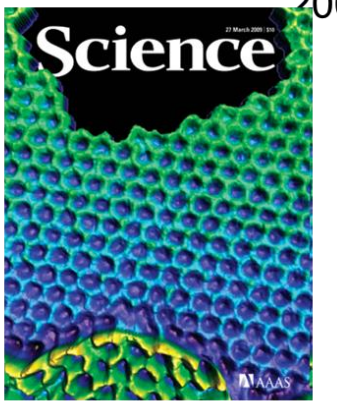
Chemical/Biological

Graphene



2006

Electrical



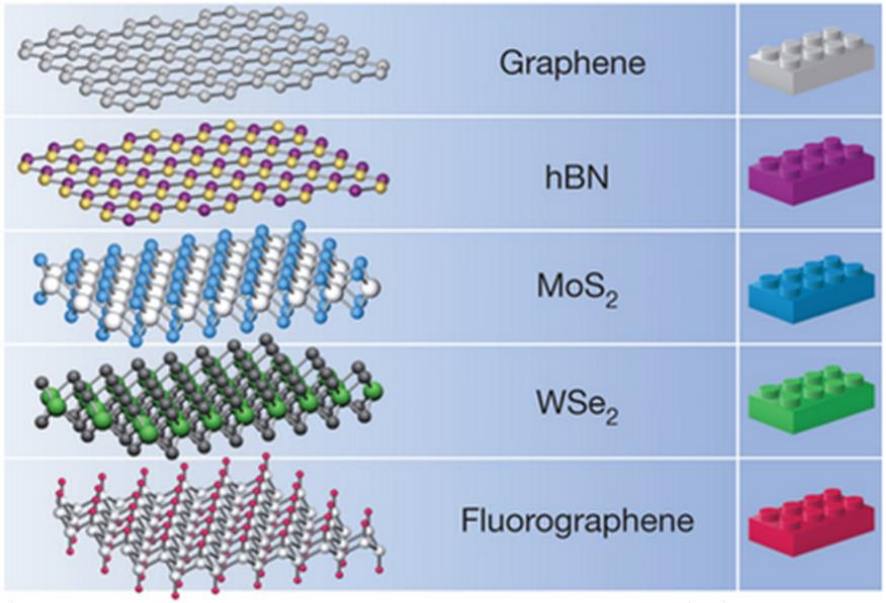
2009

Mechanical

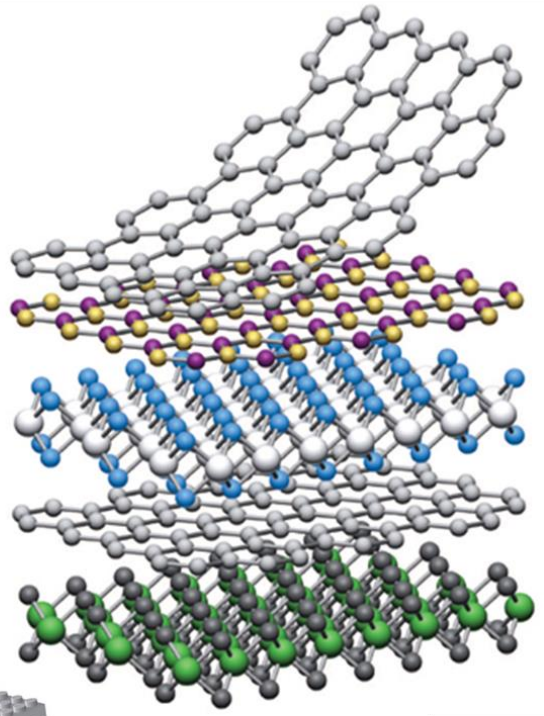
2010

Chemical/Biological

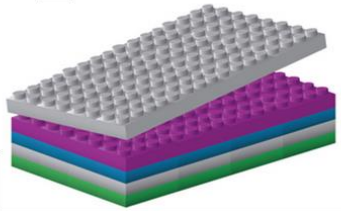
2D Materials beyond Graphene



Van der Waals Heterostructures



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



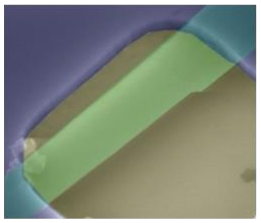
Geim et al. Science, 2013

Boston University Photonics Center
Research Experiences for Undergraduates

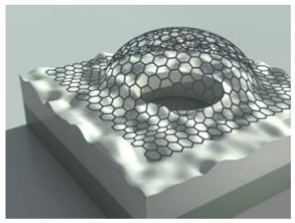
Why Atomic Membrane Mechanics?

Adhesion – Extremely Flexible Membrane

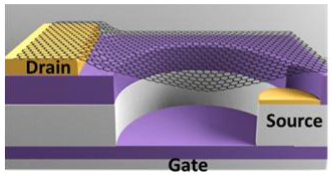
vdw forces holds sheets together
Adhesion clamps sample to substrate
Mechanics and electronics influence by substrate
Strain and flexibility dictated by adhesion



J. S. Bunch et.al. Science **315,** 490-3 (2007)



S.P. Koenig et al., Nature Nanotechnology, **6**, 543–546 (2011)



Xinghui Liu **et al**. Advanced Materials **26,** 1571-1576 (2014)

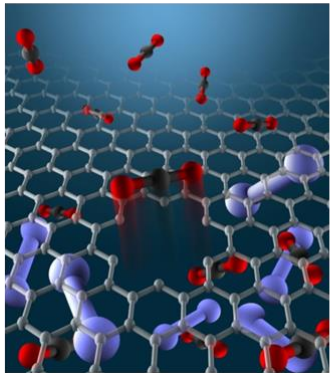
wikipedia

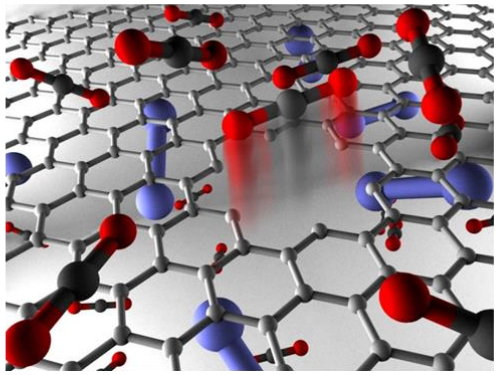
Molecular Separation

Thin membrane
Well defined pores
Single file molecular flux

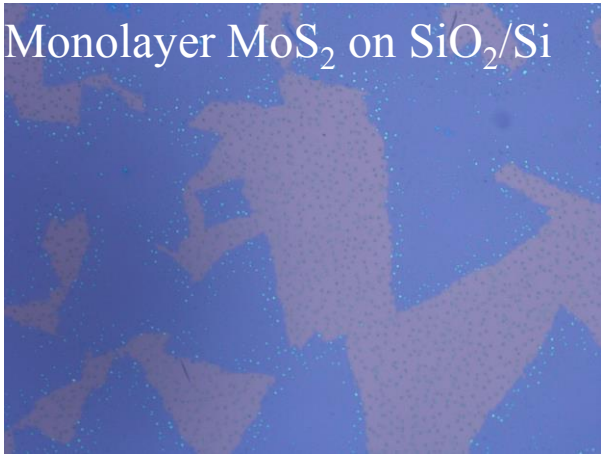
S.P. Koenig et al., Nature Nanotechnology, **7**, 728-732 (2012)

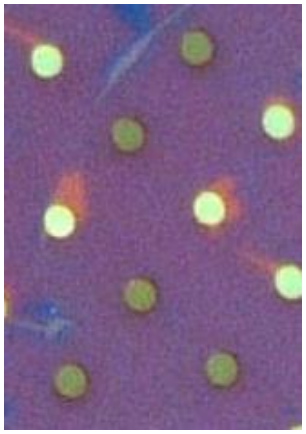
L. Wang et al., Nature Nanotechnology, **to appear** (2015)

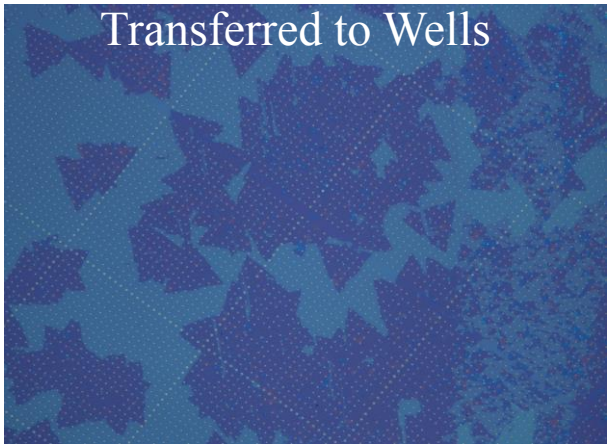


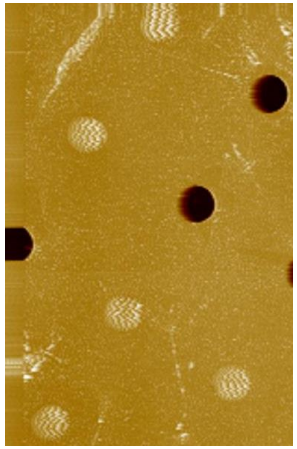


CVD MoS_2









Day to Day expectations for lab work

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- 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.