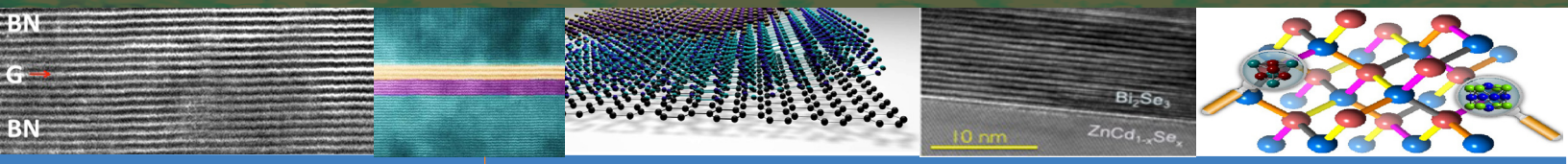
Columbia University

Exploring and Advancing the Design, Control and Fundamental Understanding of Materials Through Collaborative Experimental and Theoretical Studies



PAS3

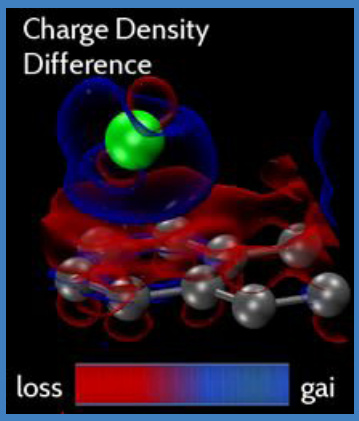
The central mission of the Columbia Center for Precision Assembly of Superstratic and Superatomic Solids (PAS^3) is to explore the theme of building higher dimensional materials from lower dimensional structures with unprecedented levels of control.

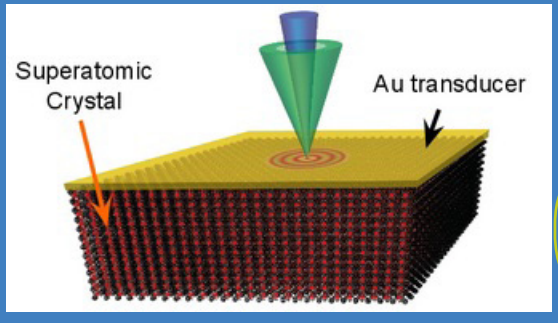
The Center for Precision Assembly of Superstratic and Superatomic Solids (PAS^3) is a collaboration between Columbia University and City College of New York to create a center of excellence in Materials Science and Engineering. Our materials research program encompasses two research thrusts (IRGs): IRG 1 combines atomically thin materials such as graphene into layered heterostructures; IRG 2 combines molecular 'superatoms' into three-dimensional solids. The unifying scheme of the two IRGs is to harness the unique properties of low-dimensional materials in higher dimensional assemblies to achieve unprecedented properties.

The MRSEC leverages the proximity of Columbia, CCNY, and Barnard for intercampus cooperation, and nearby K-12 schools for educational activities. Brookhaven National Laboratory, IBM, DuPont, and other partners provide research partnerships and educational opportunities.

HIGHLIGHTS

Highly p-doped, Chlorinated Graphene Tuning the work function for heterostructures and contacts





Orientational order controls crystalline and amorphous thermal transport in superatomic crystals

DIRECTOR: James Hone
mrsec.columbia.edu

RECENT PUBLICATIONS

August 2017: "Weaving Nanoscale Cloth through Electrostatic Templating" from the Nuckolls group is published in Journal of the American Chemical Society

January 2017: "Orientational order controls crystalline and amorphous thermal transport in superatomic crystals" Nature of the quantum metal in a two-dimensional crystalline superconductor" from the Roy group is published in Nature Materials

March 2016: "Nature of the quantum metal in a two-dimensional crystalline superconductor" from the Hone, Kim, Dean and Pasupathy groups is published in Nature Physics

INTERDISCIPLINARY RESEARCH GROUPS (IRGs)

IRG 1: Heterostructures of van der Waals Materials

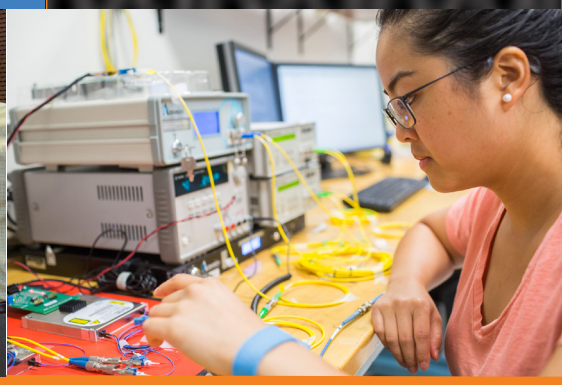
The diverse family of layered van der Waals (vdW) materials includes metals, semiconductors, insulators, and many materials hosting exotic phases of such as superconductivity, charge density waves, and topological states. The isolation of graphene in 2005 opened up the possibility of thinning all of these materials down to individual atomic sheets. IRG 1 assembles diverse atomic sheets into layered heterostructures with new properties and functionality.

IRG 2: Creating Multifunctional Materials From Superatoms

The emergence of unanticipated collective properties in clusters of atoms, which we call "superatoms," offers a new class of fundamental building units that can be used to extend the atomic periodic table for the development of new materials.

"Our research focuses on basic understanding of how to assemble these nano building blocks into materials and structures, and what properties emerge when we do so. This understanding will ultimately lead to conceptually important and useful new electronic/magnetic devices, optoelectronic systems, and thermoelectric materials"

James Hone, PAS³ Director



DIVERSE EDUCATION, OUTREACH AND PARTNERSHIP ACTIVITIES

OUTREACH

REU and RET (Research Experiences for Undergraduates and Teachers)
Participants are immersed into materials research during the summer and develop scientific writing and presentation skills.

ENG and La Guardia Community College
ENG is a research opportunity for highly motivated under-represented high school students from local partner schools. Additionally we partner with CUNY LaGuardia Community College to teach an introductory course aimed at exposing community college students to the research culture at the university level.

More information about our center, research, partnerships, and educational opportunities is available at mrsec.columbia.edu

Support for the center is provided through the NSF Grant DMR-1420634.

COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

PAS CENTER FOR PRECISION ASSEMBLY OF SUPERSTRATIC AND SUPERATOMIC SOLIDS COLUMBIA–CCNY

NSF