Yale Institute for Nanoscience and Quantum Engineering

Friday- March 25, 2016

12:00 to 1:00 p.m.

BECTON SEMINAR ROOM

Light lunch will be served at 11:45 a.m.

Xiaomu Wang

Department of Electrical Engineering, Yale University

"Highly Anisotropic and Robust Excitons in Monolayer Black Phosphorus"

Recently, black phosphorus emerged as a promising new 2D material due to its widely tunable and direct bandgap, high carrier mobility and remarkable in-plane anisotropic electrical, optical and phonon properties. However, current progress is primarily limited to its thin-film form, and its unique properties at the truly 2D quantum confinement have yet to be demonstrated. In this talk, we will discuss highly anisotropic and tightly bound excitons in monolayer black phosphorus revealed by polarization-resolved photoluminescence measurements at room temperature. We show that regardless of the excitation laser polarization, the emitted light from the monolayer is linearly polarized along the light effective mass direction and centers around 1.3 eV, a clear signature of emission from highly anisotropic bright excitons. In addition, photoluminescence excitation spectroscopy suggests a quasiparticle bandgap of 2.2 eV, from which we estimate an exciton binding energy of around 0.9 eV, consistent with theoretical results based on first-principles. The experimental observation of highly anisotropic, bright excitons with exceedingly large binding energy not only opens avenues for the future explorations of many-electron effects in this unusual 2D material, but also suggests a promising future in optoelectronic devices such as on-chip infrared light sources.

Justin Tang

Department of Mechanical Engineering and Materials Science, Yale University

"Electrosprays for Energy Conversion and Storage"

The electrospray is a liquid atomization technique that generates a monodisperse population of highly charged liquid droplets over a broad size range (nanometric to tens of microns). We demonstrate how electrosprays can be applied to mesoporous film formation for dye-sensitized solar cells (DSSC) and nanoparticle synthesis for lithium ion batteries. We show that a variety of film morphologies can be achieved and measure DSSC performance for various film microstructures and fabrication protocols. On the battery side, we develop a dual-electrospray configuration to synthesize metal oxide particles from liquid precursors and apply them to lithium ion battery anodes.

Host: Professor Eric Altman