

SEMINAR

Research Talks from the Resnick Fellows



RESNICK INSTITUTE
science + energy + sustainability



Vatsal Jhalani

Resnick Grad Research Fellow



Akira Kudo

Resnick Postdoctoral Scholar

Ab Initio Hot Carrier Dynamics and Transport in GaN

GaN and the related III-Nitride family of wide bandgap semiconductors have emerged as promising materials for efficient solid-state lighting and power electronics technologies. However, the carrier transport and ultrafast dynamics that are central in regulating device properties are poorly understood, and the ultrafast (sub-picosecond) timescale of these processes make them difficult to probe experimentally. In particular, there are important open problems in LED device design, such as the high current efficiency droop, whose microscopic carrier dynamics origin is highly debated. We present first principles calculations of carrier dynamics in GaN, focusing on electron-phonon scattering. First, I will discuss the ultrafast and nanoscale dynamics of hot carriers and our findings of an asymmetry between the cooling rate of electrons and holes. I will discuss the origin of this asymmetry and how it leads to a new explanation for efficiency droop in GaN LEDs. Lastly, I will present the first ab initio calculations of the phonon-limited mobility in GaN, and discuss microscopic insights provided by our calculations.

3D Printed Carbon Microlattices Integrating Structural and Functional Materials

3D printing has become a powerful engineering tool for fabricating structures difficult to create with conventional techniques. Thermoelastic polymer, ceramics, glasses, and metals have all been 3D printed into micro- and nanostructures. Carbon is also a material that can be 3D printed. By pyrolyzing 3D-printed photoresist polymer structure derived from stereolithography, a replica with reduced dimensions made of amorphous carbon can be obtained. Carbon microlattices created in this way have shown excellent mechanical strength given the low density, with the unit cell size of 300 microns and the beam diameter 80-90 microns. Furthermore, rapid Joule heating can convert a pyrolyzed amorphous carbon microlattice into a graphitic carbon microlattice, with improved electrical conductivity, unique surface properties, and retained compressive strength.

11:00 am - NOON | Wednesday, 10/11/17
Guggenheim 133 Lees-Kubota Lecture Hall
Caltech Campus | resnick.caltech.edu

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