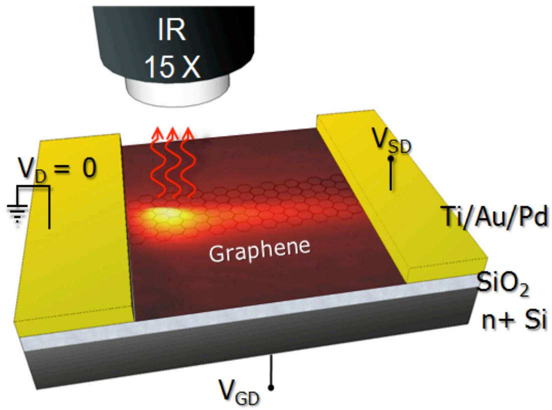
# NANOHOUR

Wednesday, November 11, 2009 3:00 pm
Beckman Institute - Room 3269

## Imaging of Ambipolar Power Dissipation in Graphene Transistors

### Myung-Ho Bae – Electrical and Computer Engineering

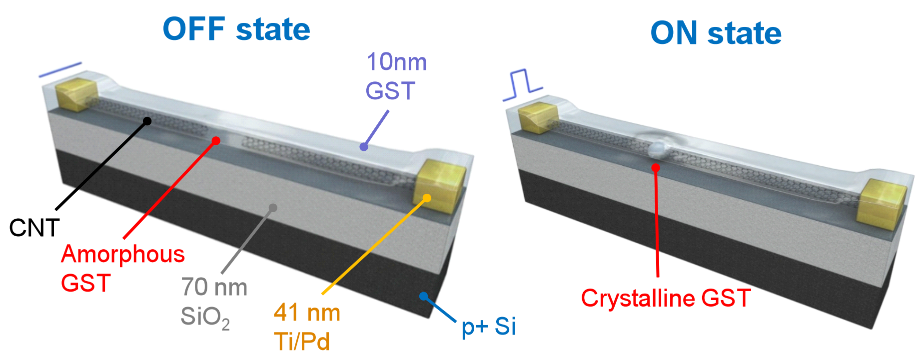



Power dissipation is a key challenge in modern and future integrated electronics. Graphene is a promising new material in this context, given its high electrical and thermal conductivity, both over an order of magnitude greater than silicon. In this presentation, we will show images of the temperature distribution in mono- and bilayer graphene field effect transistors (GFETs) using infrared (IR) microscopy. The temperature profile is correlated to the power dissipation, carrier distributions and electric fields within the device, providing rich insight into its operation and energy relaxation physics. The hot spot is very sensitive to device electrostatics, and moves between electrodes as the majority carriers change from holes to electrons. During ambipolar transport, the graphene hot spot marks the position of charge neutrality. This allows the imaging of the inhomogeneous charge density profile of the ambipolar GFET channel under high bias voltages.

## Energy-Efficient Memory Devices with Phase-Change Materials and Carbon Nanotube Electrodes

### Feng Xiong, Albert Liao – Electrical and Computer Engineering

Phase-change materials (PCM) like $Ge_2Sb_2Te_5$ (GST) have been proposed for non-volatile memory and reconfigurable electronics [1,2]. One of the drawbacks associated with this technology is the relatively high (~0.5 mA) programming currents required [3]. In this work, we demonstrate GST antifuse switching with individual carbon nanotube (CNT) electrodes and extremely low switching power. The SET currents are as low as 1 μA, two orders of magnitude lower than present state-of-the-art, enabled by a very small addressable phase change volume, estimated as low as 10×10×10 $nm^3$. This work also shows that GST can be used to "repair" broken CNT connections, paving the way toward reconfigurable CNT electronics.




(**A**) Schematic of the reconfigurable device by sputtering $Ge_2Sb_2Te_5$ on top of a carbon nanotube with a nano-scale gap. The device in OFF state as GST that filled up the gap is in resistive amorphous phase. (**B**) The device is switched to ON state when GST in the gap is transformed into highly conductive state under high E-field across the gap.

**Coffee and Cookies will be served**

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