UCF | NanoScience Technology Center

UNIVERSITY OF CENTRAL FLORIDA

GRADUATE RESEARCH SEMINAR SERIES

Friday
October 13, 2017

12:45 PM

Research Pavilion
NSTC
Conference Room 169

Pizza and drinks will be provided

Near-ideal Channel/Dielectric Interfaces Enabled by 2D/2D van der Waals Heterostructures

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Two-dimensional (2D) material systems have aroused immense interest in research due to the possibility of obtaining thickness uniformity down to a monolayer without surface dangling bonds. Graphene, as a two-dimensional semi-metal has been studied extensively for the purpose of analog and digital applications and Transition metal dichalcogenides (TMDC), with an inherent bandgap, tunable by composition and the number of layers, have ignited significant interest and promise over the past few years for both electronic and optoelectronic applications. One of the primary advantages of these layered materials is, in principle, the absence of dangling bonds, which rules out performance degradation due to interface states.

In this work we probe the superior quality of a 2D/2D interface by fabricating field effect transistors with Molybdenum disulfide as the channel material and hexagonal boron nitride as the gate dielectric and the trap densities are extracted at the 2D channel/2D dielectric interface. To extract interface trap densities, we use the highly sensitive and direct conductance method, which can detect trap densities as low as ~10^9 states/cm^2-eV . A low interface trap density of ~10^{11} states/cm^2-eV is extracted at the MoS_2/h-BN 2D/2D interface without any surface treatment or annealing. Around 7´10^{10} states/cm^2-eV mid-gap interface trap density is obtained after forming gas annealing, which brings this system at par with the conventional Si/SiO_2 system where the mid-gap trap densities are around ~10^{10} states/cm^2-eV. This work establishes that van der Waals systems with 2D/2D interfaces can yield high performance electronic and opto-electronic devices.