University of Central Florida
NanoScience Technology Center
Advanced Materials Processing & Analysis Center

GRADUATE RESEARCH SEMINAR SERIES

Friday
October 21, 2016

12:15 PM

Research Pavilion
NSTC
Room 169

Pizza and drinks will be provided

High-Yield Wafer-Scale Growth and Transfer of 2D TMD Hetero-Materials for Emerging Stretchable Electronics

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Two-dimensional (2D) Transition Metal Dichalcogenides (TMDs) offer a rich set of extraordinary material properties unattainable from any other materials owing to their unique anisotropic crystalline structure and near atom layer thickness. Amongst these properties, unusual combination of large elasticity (>4x larger in-plane strain limit over Silicon (Si)) and tunable band gap energies (~1.2 eV to – 1.8 eV) make 2D TMDs particularly promising for stretchable devices in emerging electronics and opto-electronics. Heterostructured materials based on a stack of multiple 2D TMDs can present even more exotic properties owing to their unique 2D/2D interfaces, further broadening the versatility of 2D materials for such applications. Conventional fabrications of these materials have relied on the low-yield manual exfoliation/stacking of individual 2D TMDs layers which are still impractical for scaled-up applications. Direct chemical vapor deposition (CVD) growth on unconventional stretchable substrates such as plastics has been impossible due to the high-temperature nature of the CVD process. In this seminar, I will talk about a novel and facile method to transfer large-area CVD-grown 2D TMDs heterostructures to arbitrary substrates with nearly 100 % yield and their potential applications for stretchable electronic devices. The presented method is based on the use of thin sacrificial layers, i.e., noble metals, as growth substrates which are easily separated upon an exposure to water owing to their weak adhesion properties. Comprehensive structural characterizations employing Raman spectroscopy and transmission electron microscopies (TEMs) confirm that transferred materials well maintain the structural integrity of their as-grown states. Our approach can overcome the present growth and integration bottlenecks of 2D TMD heterostructures, enabling their scalable production compatible with current manufacturing technologies. Ultimately, we aim at realizing their extraordinary nanoscale properties at macroscopic, practical technologies in the emerging areas of stretchable electronics and optoelectronics.