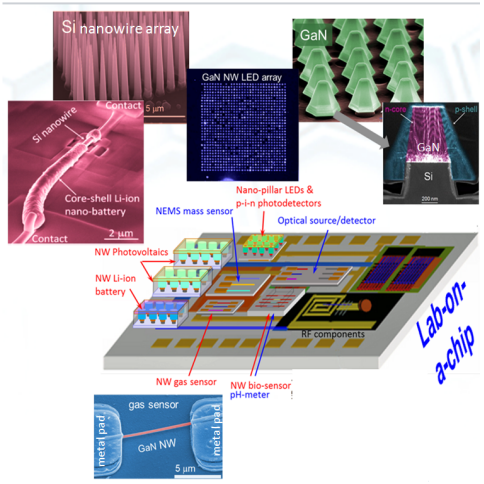
CHiMaD | Center for Hierarchical Materials Design

MATERIALS GENOME INITIATIVE SEMINAR SERIES

Low-dimensional Semiconductors for Electronics, Sensors, and Energy

Dr. Albert Davydov
Materials Science and Engineering Division, NIST



April 30, 2015 (Thursday) | 10.00am
CHiMaD, Hogan 1160 (1st Floor)

ABSTRACT In addition to conventional thin films for semiconductor devices, low-dimensional nanostructures such as nanowires and atomically thin layers have attracted considerable attention due to their unique electronic, magnetic, optical, thermal and mechanical properties, complemented with superior structural quality and high surface-to-volume ratio. Semiconductor nanowires and graphene-like 2D layers are emerging as potential nanoscale building blocks for on-chip integration for flexible hybrid electronics, sensors, photodetectors, batteries, etc. To realize new applications, the controlled fabrication of nanowires and 2D layers with defined geometries and electronic properties as well as their integration with planar device structures is required. This talk discusses fabrication and characterization of silicon and gallium nitride nanowire materials and devices, including single and arrayed nanowire transistors, chemical and bio- sensors, Li-ion batteries, and LEDs. A special case of developing scalable periodic arrays of vertically aligned GaN core-shell nanostructures for p-i-n photodetectors, realized with a combination of top-down etch and subsequent chemical vapor deposition is presented. The 2D-layer research is illustrated by fabrication and testing of field-effect-transistors (FETs) composed of mono- to few-layer MoS_2 thin films, where device transport characteristics are governed by inter-layer coupling and electrically active surface states. Strategies to overcome hurdles toward fabricating large-area nanowire and 2D-layer material and device platforms will be discussed.

Albert Davydov *received his Ph.D. in Chemistry from Moscow State University (Russia) in 1989. He joined NIST in 2005 and is now active in the area of semiconductor nanowires and 2D materials and devices. He is presently a Leader of Functional Nanostructured Materials Group, and a Project Leader on "Low-dimensional semiconductors for sensors, optoelectronics and energy applications" at the Materials Science & Engineering Division at National Institute of Standards and Technology (NIST, Gaithersburg, MD). Dr. Davydov's expertise is with metal and semiconductor materials bulk crystal growth, thin film deposition, and the processing and characterization of a wide range of nanostructured electronic materials and device structures, including silicon, gallium nitride and metal oxide nanowires and transition metal dichalcogenide 2D layers. He serves as a Head of the Semiconductor Task Group for the International Centre for Diffraction Data (ICDD); Co-chair of the Reference Materials Task Group on Compound Semiconductors at ASTM; Leader of the review team for the NSF-NRI program on "Nanoelectronics for 2020 and Beyond", and co-organizer of the 6th International Conference on One-dimensional Nanostructures (ICON-2016).*