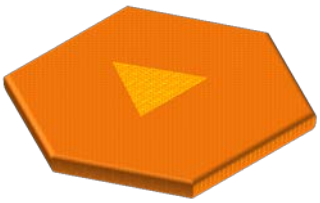
Growth and Electrical, Nano-Optical Characterization of semiconducting MoS_2/WS_2 in-plane Heterostructures

Sourav Garg, Seongsin M. Kim, and Patrick Kung
Department of Electrical and Computer Engineering, The University of Alabama, Box 870286, Tuscaloosa, AL 35487-0286 USA (Tel: +12053481764, Fax: +12053486959)
(sgarg5@crimson.ua.edu, patkung@eng.ua.edu)



In-plane heterojunctions of atomic-thick (2D) semiconductors (MoS_2/WS_2) are novel structures that can potentially pave the way for efficient ultrathin and flexible optoelectronics, such as light sources and photovoltaics. Such heterostructures (HS) are very rare and not much is known about their characteristics. They can only be achieved through a synthetic growth process such as chemical vapor deposition (CVD). This is unlike vertical heterostructures, for which the materials can be mechanically stacked one layer on top of the other. The CVD growth of in-plane heterostructure is a thermodynamically driven process and presents a number of challenges to control the vapor pressure of the precursors. Additionally, new analytical tools need to be developed in order to gain access to and understand the physical properties of these HS.

Here, we report a one-step CVD growth of monolayer (1 nm) thick MoS_2/WS_2 in-plane heterostructures. We have characterized their morphological and optical properties using micro-Raman and photoluminescence spectroscopy. Kelvin probe force microscope was used to extract the surface potential profile across the MoS_2/WS_2 heterojunction boundary, which was then used to gain access to fundamental semiconductor heterostructure parameters such as depletion layer width and built-in field across the MoS_2-WS_2 interface.

POSTER PRESENTATION