

Announcing the Final Examination of Sajeevi Withanage for the degree of Doctor of Philosophy in Physics

Date: March 31, 2021

Time: 9:30 am

Room: Zoom Meeting:

<https://ucf.zoom.us/j/91279489868?pwd=NkVpWk1xYlpuVBMdGZVL2Y1OGp2Zz09>

Dissertation title: Chemical vapor deposition growth of transition metal dichalcogenides and their heterostructure integration

Abstract:

Two dimensional (2D) transition metal dichalcogenides (TMDs) are of great interest for the discovery of many novel physics owing to their extraordinary electrical, optical, mechanical properties as well as many promising applications including heterojunction. In order to realize the overreaching goals of these materials, it is important to develop scalable growth techniques and investigate the role of different growth parameters on the resulting material properties. In this dissertation, I study, (i) controllable and reproducible growth of monolayer molybdenum disulfide (MoS_2) via chemical vapor deposition (CVD), (ii) the role of growth temperature on the properties of large area MoS_2 thin films grown via thermal vapor sulfurization route, and (iii) low temperature growth of palladium diselenide (PdSe_2) thin films, their doping and integration into heterojunctions. In particular, for the growth of MoS_2 monolayer crystals, I modified the CVD process by using molybdenum trioxide thin films as a precursor addressing the difficulty of controlling the local variations of the precursor concentrations in the conventional method resulting in highly reproducible MoS_2 crystal growth. For large area MoS_2 thin films, I show that the electrical properties of the samples change significantly with growth temperature and discuss the challenges in using Si/SiO₂ substrates for the direct growth of these films, specially at high temperature. For PdSe_2 thin film, I studied the changes in electrical, chemical, and crystalline quality of the PdSe_2 at growth temperatures below 400 °C and showed its integration with molybdenum diselenide to fabricate a vertical heterojunction diode with a high rectification ratio. I have also investigated the surface charge transfer doping of PdSe_2 devices and used it toward fabrication of lateral heterojunction diode by selective area doping.

Outline of Studies:

Major: Physics

Educational Career:

M.S. University of Akron, Ohio, 2015

B.S. University of Colombo, Colombo, Sri Lanka, 2011

Committee in Charge:

Dr. Saiful Khondaker (Chair)

Dr. Talat Rahman

Dr. William Kaden

Dr. Yeonwoong Jung (External Committee Member)

Approved for distribution by Dr. Saiful Khondaker, Committee Chair, on 3/16/2021

The public is welcome to attend remotely.