



Colloquium

Department of Engineering and System Science,
Institute of Nuclear Engineering and Science,
National Tsing Hua University

Synthesis and Low-Energy Ion Implantation of 2D Transition Metal Dichalcogenides Semiconductors

In this talk, the following content will be presented:

Two-dimensional (2D) transition metal dichalcogenides (TMDC) exhibit exciting properties and versatile material chemistry for transistors, optoelectronic devices, quantum information science, and energy missions. Metalorganic chemical vapor deposition (MOCVD) has emerged as a promising technique to grow 2D TMDC due to its ability to carry out high-temperature epitaxial growth and to maintain the ratios of chalcogen/transition metal precursor flows during the process. First, I will discuss our MOCVD process for the growth of 2D TMDC on sapphire and graphene substrates and its capabilities for low-temperature deposition on functionalized surfaces or a damascene structure. Next, I will talk about our recent progress on the substitutional doping of TMDC with Re and V during TMDC growth. Some dopants can modulate carrier concentrations, introduce magnetism, and even heal defects in TMDC. I will also introduce low-energy implantation based on pulsed laser deposition (PLD) that can turn regular TMDC into Janus TMDC, such as MoSSe and WSSe with sulfur on one surface and selenium on the other. This approach can break the symmetry of 2D TMDC to create an out-of-plane dipole moment inside them that was recently confirmed. Finally, few-layer-thick TMDC semiconductors might be of interest for device applications to reduce the thermal ionization energy typically too large for room temperature applications in their monolayer counterparts and to improve some aspects of TMDC transistor performance. Toward the end of my talk, I will show how we tailored the MOCVD process to grow epitaxial 2-to-4-layer MoS₂, layer-by-layer, on sapphire and the characterization results.

15:30-17:00, Wednesday, December 20th, 2023

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Biography:



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EDUCATION

The Pennsylvania State University (2017)

Ph.D. in Materials Science and Engineering

National Taiwan University (2011)

M.S. in Physics

National Cheng Kung University (2009)

B.S. in Physics

WORK EXPERIENCE

Assistant Professor, MSE of National Yang Ming Chiao Tung University, **3/2023-Current**

Assistant Research Professor, MatSE of The Pennsylvania State University, **4/2021-2/2023**

Postdoctoral Researcher, MatSE of The Pennsylvania State University, **6/2020-3/2021**

Postdoctoral Researcher, CNMS of Oak Ridge National Laboratory, **11/2017-5/2020**