

# ISGD7

7th International Symposium on Graphene Device  
26 - 29 July, 2021 / WASHINGTON, D.C

---

## **Epitaxial Growth and Properties of Wafer-Scale Transition Metal Dichalcogenides for Large Area Device Applications**

Joan M. Redwing

Department of Materials Science and Engineering  
The Pennsylvania State University, University Park, PA 16802 USA

Wafer-scale synthesis of semiconducting transition metal dichalcogenide (TMD) monolayers such as MoS<sub>2</sub>, WS<sub>2</sub> and WSe<sub>2</sub> is of significant interest for device applications to circumvent size limitations associated with the use of exfoliated flakes. Epitaxy is required to achieve single crystal films over large areas via coalescence of TMD domains with the same crystallographic direction.

In this talk, I will discuss the prospects and challenges associated with the epitaxial growth of TMD monolayers and heterostructures for the development of wafer-scale 2D device technologies. Metalorganic chemical vapor deposition is highlighted as a promising approach which enables growth at high temperatures (>700°C) and large chalcogen overpressures which are needed to obtain stoichiometric epitaxial films. The unique aspects of van der Waals epitaxy of TMDs will be presented including the role of substrate defects, steps, and surface passivation. The properties of wafer-scale TMD monolayers grown by MOCVD will be discussed in comparison to exfoliated flakes. Applications for large area TMD films in electronics, sensing and photonics will also be highlighted.