Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Fluid-Guided Chemical Vapor Deposition Growth for Large-Scale Monolayer Two-Dimensional Materials[1] JI LANG, DONG ZHOU, NICHOLAS YOO, Villanova University, RAYMOND YOO, Oak Ridge National Laboratory, QIANHONG WU, BO LI, Villanova University, CELLULAR BIOMECHANICS AND SPORTS SCIENCE LABORATORY TEAM — Atmospheric pressure chemical vapor deposition (APCVD) has been used extensively for synthesizing two-dimensional (2D) materials because of its low cost and promise for high-quality monolayer crystal synthesis. However, the understanding of the reaction mechanism and the key parameters affecting the APCVD processes is still in its embryonic stage. Hence, the scalability of the APCVD method in achieving large-scale continuous film remains very poor. Here, we use MoSe2 as a model system and present a fluid guided growth strategy for understanding and controlling the growth of 2D materials. Through the integration of experiment and computational fluid dynamics (CFD) analysis in the full-reactor scale, we identified three key parameters, precursor mixing, fluid velocity, and shear stress, which play a critical role in the APCVD process. By modifying the geometry of the growth setup to enhance precursor mixing and decrease nearby velocity shear rate and adjusting flow direction, we have successfully obtained inch-scale monolayer MoSe2. This unprecedented success of achieving scalable 2D materials through fluidic design lays the foundation for designing new CVD systems to achieve the scalable synthesis of nanomaterials.

[1]NSF CBET FLuid Dynamics Program under Award Number 1511096; DOE Visiting Faculty Program (VFP)

Ji Lang
Villanova University

Date submitted: 02 Aug 2020 Electronic form version 1.4