

## Synthesis of Large Area 2-Dimensional MoS<sub>2</sub> and WS<sub>2</sub> by Physical Vapor Deposition Individual Sponsor

1. **Research Title:** Synthesis of Large Area 2-Dimensional MoS<sub>2</sub> and WS<sub>2</sub> by Physical Vapor Deposition
2. **Individual Sponsor:**

Dr. Michael H. Check, AFRL/RXAN  
3005 Hobson Way, Bld. 651, Rm 114  
WPAFB, OH 45433  
micahel.check.2@wpafb.af.mil
3. **Academic Area/Field and Education Level:** Materials Science and Engineering/  
Nanoelectronic Materials/ Biosensing; Ph.D. level
4. **Objectives:** Develop scalable methods for the synthesis of 2-dimensional (2D) semiconductor architectures for devices with tunable electronic properties for ultra-compact high-performance electronics and sensors.
5. **Description:** Uniform growth of pristine two dimensional (2D) materials over large areas at lower temperatures without sacrifice of their unique physical properties is a critical pre-requisite for seamless integration of next-generation functional devices. The materials are needed for applications in flexible electronics, energy harvesting systems, and chemical/biological sensors. Single molecular layers of transition metal dichalcogenide (TMD) compounds (e.g., MoS<sub>2</sub> and WS<sub>2</sub>, etc.) provide a direct band gap, optical transparency, strong photoluminescence, electrical resistance sensitivity to ambient chemical agents, and accommodation of >10% mechanical strain without fracture. Currently mechanical exfoliation and high temperature chemical-vapor deposition are being used, followed by complex 2D film lift and transfer processing. While this process is useful, it cannot create pristine quality wafer scale synthesis of continuous 2D materials. Thus, techniques for reduced temperature and scalable techniques for 2D materials synthesis are needed to realize these remarkable materials in applications of interest to the Air Force and DoD.
6. **Research Classification/Restrictions:** Not classified. Not restricted.
7. **Eligible Research Institutions:** Indicate to what organizations this topic should be provided.



DAGSI (Wright State University, AFIT, Ohio State University, University of Dayton, Miami University, Ohio University, University of Cincinnati)  
PA Approval #: 88ABW-2013-3021