

RX15-24


1. **Research Title:** Synthesis of 2-Dimensional Heterostructures
2. **Individual Sponsor:** List the AFRL research topic sponsor's contact information

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3. **Academic Area/Field and Education Level**

Materials Science and Engineering/ Nanoelectronic Materials/ Biosensing; Ph.D. level

4. **Objectives:** Develop scalable methods for 2-dimensional (2D) conductor-dielectric-semiconductor architectures for devices with tunable electronic properties for ultra-compact high-performance electronics and sensors.
5. **Description:** Development of large area and reduced temperature growth methods for two dimensional (2D) conducting, semiconducting, and dielectric materials and their heterostructures is needed for applications in flexible electronics, energy harvesting systems, and chemical/biological sensors. Single molecular layers of transition metal dichalcogenide (TMD) compounds (e.g., MoS₂, WS₂, MoSe₂, 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. 2D films of hexagonal BN can provide the necessary dielectric gate materials, and 2D graphene provides high mobility conductors. However the state of the art in the 2D multi-layered heterostructure synthesis with controlled materials properties is far from that required for predicted applications. Currently mechanical exfoliation and high temperature chemical-vapor deposition are being used, followed by complex 2D film lift and transfer processing. Reduced temperature and scalable techniques for 2D heterostructures 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) NOTE: Topics submitted to DAGSI must be approved for public release. Need PA Approval #88ABW-2013-3021