

## 2-Dimensional Materials for Optoelectronic Devices

1. **Research Title:** 2-Dimensional Materials for Optoelectronic Devices

2. **Individual Sponsor:**

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

Materials Science and Engineering/ Physics/Electrical Engineering (M.S. or Ph.D. level)

4. **Objectives:** Research of 2-dimensional materials (e.g., WSe<sub>2</sub>, MoS<sub>2</sub> and black phosphorus) with bandgaps ranging from UV to IR for single photon emitters and detectors. Research involves device fabrication and measurements of optical and electrical properties.

5. **Description:** Two-dimensional (2D) transition metal dichalcogenide (TMDC) materials (e.g., MoS<sub>2</sub>, WS<sub>2</sub>, etc.) cover a wide electromagnetic spectrum ranging from UV to IR. There is a need for a photodetection platform with higher performance in terms of speed, efficiency or wavelength range. Along with graphene, other 2D materials such as TMDCs are being considered due to their tunable bandgap, enabling their application in areas of interest to AFRL including ultrafast and ultrasensitive detection of light from UV to IR. In addition to photodetection, mono- to few layers of 2D TMDCs (such as WSe<sub>2</sub>) have demonstrated strong photoluminescence in the visible and near IR. In this topic, we will perform optical studies of WSe<sub>2</sub> (and other 2D materials) for single photon emission. Narrow line emitting centers (NLECs) have been reportedly observed from flakes of WSe<sub>2</sub>, which are characteristic of single photon emitters. Micro-photoluminescence measurements of various 2D TMDCs materials in the form of quantum dots and thin films will be performed to study these NLECs from the UV to IR range. Photodetection studies will consist of fabrication and characterization of 2D photodetectors, and heterostructures consisting of graphene layered with 2D materials. As the need for better performance in photodetection and emission becomes more eminent, the Air Force is considering these next generation materials for optoelectronic applications.

6. **Research Classification/Restrictions:** Not classified. Not restricted.

7. **Eligible Research Institutions:** Indicate to what organizations this topic should be provided



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