RX19-14

1. **Research Title:** Studies of Ultra-Wide Bandgap Materials for Power Electronics and RF Power Electronics Applications

2. **Individual Sponsor:**

Dr. Adam T. Neal, AFRL/RXAN
AFRL/RXA
2179 12th St., B652/R122
WPAFB, OH 45433-7717
adam.neal.3@us.af.mil
937-255-9136

3. **Academic Area/Field and Education Level:** Electrical Engineering, Physics, Materials Science and Engineering (M.S. or Ph.D. Level)

4. **Objectives:** Study the growth and/or electronic properties of ultra-wide bandgap materials (bandgap ≥ 4 eV), including but not limited to Gallium Oxide (Ga_2O_3) and Aluminum Gallium Nitride (AlGaN), to understand a subset of the following: transport, doping, defects, dielectric interface, metal-semiconductor interface, ohmic contacts, heterostructures, and/or the effects of material growth on these properties.

5. **Description:** The recent maturity of solid state devices based on Gallium Nitride and Silicon Carbide has increased the maximum operating power of solid state power electronics and radio frequency (RF) power electronics devices, enabling higher output powers and reduced size and weight for systems based on these devices. With the success of these materials, there is a natural motivation to search for next generation ultra-wide bandgap materials to further enhance the performance of solid state power electronics and RF power electronics. Ultra-wide bandgap materials are those with a bandgap higher than Gallium Nitride (GaN) and Silicon Carbide (SiC), whose bandgaps are 3.4eV and 3.3eV respectively. Gallium Oxide (Ga_2O_3), with its bandgap of 4.5 eV, and Aluminum Gallium Nitride (AlGaN), with bandgaps as high as 6.2 eV for binary AlN, are examples of candidate materials which could further improve power electronics and RF power electronics device performance due to their larger bandgaps and resulting larger critical breakdown electric fields. In order to realize practical technologies based on these materials, an understanding of their material properties and those of their heterostructures, including transport, doping, defects, dielectric interface, metal-semiconductor interface, and ohmic contacts, is essential. In addition, understanding how material growth affects these properties is also critical. Candidates should grow and/or characterize ultra-wide bandgap materials in order to evaluate and/or improve properties of interest to enable future electronics technologies based on ultra-wide bandgap materials.

6. **Research Classification/Restrictions:** Unclassified and without ITAR restrictions.

7. **Eligible Research Institutions**: Ohio State University, Wright State University, University of Dayton, Miami University, University of Cincinnati, Air Force Institute of Technology