1. **Research Title:** Wide and Ultra-Wide Bandgap Materials for Extreme Environment Applications

2. **Individual Sponsor:**

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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 wide and/or ultra-wide bandgap materials, including but not limited to Silicon Carbide, Gallium Nitride, Aluminum Gallium Nitride (AlGaN), and Aluminum Gallium Oxide ($(Al_xGa_{1-x})_2O_3$), 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 – towards the application to extreme environments such as high radiation and high temperatures.

5. **Description:** The recent maturity of solid state devices based on Gallium Nitride (GaN) and Silicon Carbide (SiC) has found commercially viable application to solid state power electronics and radio frequency (RF) power electronics devices, with enhanced performance enabled by their larger bandgap compared to Silicon. Ultra-wide bandgap, such as Aluminium Gallium Nitride (AlGaN) and Galium Oxide (Ga_2O_3) materials may continue this trend, leveraging bandgaps even larger than those of GaN and SiC. Though the promise of these materials for RF and power electronics applications is well established, the performance of these materials remain relatively untested in extreme environments, including high temperature (T > 300C) and high radiation (e.g. heavy ion linear energy transfer >10 MeV-cm^2/mg). In order to extend the application of wide bandgap materials and/or ultra-wide bandgap materials to extreme environments, 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 wide-bandgap and/or ultra-wide bandgap materials in order to evaluate and/or improve properties of interest to enable future extreme environment electronics technologies based on these materials.

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

7. **Eligible Research Institutions:** Air Force Institute of Technology (AFIT); the University of Akron (UA); Bowling Green State University (BGSU); Central State University (CSU); the University of Cincinnati (UC); Cleveland State University (CSU); the University of Dayton (UD); Kent State University (KSU); Miami University (MU); The Ohio State University (OSU); Ohio University (OU); Shawnee State University (SSU); University of Toledo (UT); Wright State University (WSU); Youngstown State University (YSU); Case Western Reserve University (CWRU); and Northeastern Ohio Medical University

8. **PA Approval #:** AFRL-2023-4061