RX15-3

1. **Research Title:** Multiferroic Oxide Heterostructure Materials for RF Components
2. **Individual Sponsor:** List the AFRL research topic sponsor's contact information

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

Electrical Engineering, Materials Science and Engineering, Physics (MS or Ph.D. level)

4. **Objectives:** Research and develop voltage tunable multiferroic heterostructures for microwave devices with low loss at frequencies > 1 GHz. Research areas include: (a) deposition processes for multiferroic heterostructures; (b) measurements of microwave properties of multiferroic thin films, such as loss and ferromagnetic resonance frequency; (c) measurements of tunable dielectric and magnetic properties; and (d) modeling and measurements of interface properties.
5. **Description:** Multi-functional oxide materials are the key to creating new RF passive components. Specifically, these components are enabled by the use of multiferroic materials, where two or more of the primary ferroic properties, ferroelectric and ferromagnetic, are united within one material by design. In these hybrid materials, applying an electric field to the ferroelectric is used to tune the magnetic properties of the ferrimagnet which enables a variety of frequency agile RF components, such as isolators, phase shifters, filters and circulators. Magnetoelectric (ME) coupling enables electric field control of the magnetization in mutiferroics. To create large ME coupling coefficients multiferroic composites are fabricated either by layering, ferroelectric and ferromagnetic materials, or by creating other more complex 3-D composites. The goal of this research project is to assess various potential mutlferroic material combinations for frequency agility at frequencies > 1GHz and to determine the optimized deposition parameters and interface conditions. Key issues to be addressed include: (1) ME coupling strength across interfaces; (2) development of compatible contact layers; (3) fabrication processes for single crystal oxide hybrids; and (4) broad ferromagnetic resonance frequency tuning from 1 to ≥10 GHz.
6. **Research Classification/Restrictions:** This research has no ITAR restrictions.
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-2013-3293