

DAGSI Research Topic Proposal

1. **Research Title:** Oxide ferroelectric materials for memristor and FeFET devices
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Materials and Electrical Engineering (MS or PhD level)
4. **Objectives:** Research of oxide materials (e.g., BTO, BST, and STO) with ferroelectric behavior (e.g., polarization switching). This research will focus heavily on material growth, characterization and device fabrication.
5. **Description:** Neuromorphic computing has attracted significant attention for next generational information processing systems due to faster, more power-efficient complex calculations with a smaller footprint than traditional von Neumann architectures. Emulation of synaptic plasticity is a critical requirement for brain-like learning in neuromorphic systems. Finding proper materials to fabricate nanoscale synapses and neurons that are reliable, durable, replicable, and scalable remains a challenge. Oxide materials (e.g., barium strontium titanate and barium titanate) are ideal candidates for memristor or ferroelectric FET (FeFET) synaptic memory devices due to their polarization switching properties. The goal is to demonstrate that oxide materials (e.g., BST and BTO) have fast and non-volatile switching, enabling tuning of the transistor channel conductivity, which mimics synaptic weight update in the brain. The polarization switching behavior will be studied as a function of pulse duration, pulse amplitude, and retention time. In addition, the field and temperature dependence in switching will be modelled. Use of pulsed laser deposition for film growth allows fine tuning of composition and doping, resulting in high-quality ferroelectric films with phase stability. These ferroelectric materials will provide fast switching and long retention for advanced pattern recognition and autonomous control in future AF systems.
6. **Research Classification/Restrictions:** Not classified. Not ITAR.
7. **Eligible Research Institutions:** 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 #