

Attachment 1 – DAGSI Research Topic Template

NOTE: Under the Cooperative Agreement, Technical Directorates have three options for topics. First, a topic can strictly be considered in the pool for the state allocation of funding. DAGSI will work across the TDs for this allocation. Second, the TD can be prepared to be a funding partner with the State of Ohio. This would include: providing additional funds to support additional recipients of a topic, or expand the proposers team to include additional members on a topic. Third, the TD may elect to fully fund a topic not selected for State of Ohio funding or to pursue University teams outside the State of Ohio. Contact lindsay.kotouch.2@us.af.mil for questions.

1. **Research Title:** Quantification of Ceramic Constituents
2. **Individual Sponsor:** List the AFRL research topic sponsor's contact information

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

Mechanical Engineering, Materials Science. Masters/PHD

4. **Objectives:** To overcome the limitations of traditional bulk testing, this research integrates two advanced, complementary experimental techniques to isolate and observe constituent behavior directly under load:

Targeted Micro-Mechanical Testing: We will utilize focused ion beam (FIB) milling to fabricate site-specific geometries—such as micro-pillars and micro-cantilevers—directly from individual constituents. In-situ mechanical testing, including nanoindentation and micro-compression within a scanning electron microscope, will extract the fundamental mechanical properties (elastic modulus, yield behavior, and local fracture toughness) of isolated phases. This isolates the true constituent response from the confounding effects of the surrounding bulk matrix.

Synchrotron X-ray Characterization: To observe how these constituents interact within a bulk volume, we will leverage high-energy synchrotron X-ray techniques, such as High-Energy X-ray Diffraction Microscopy (HEDM) and micro-computed tomography (μ -CT). These operando techniques will non-destructively map 3D strain tensor fields and track subsurface damage accumulation—like micro-cracking and phase transformations—in real-time as the material undergoes applied thermomechanical loading.

5. **Description:** Advanced structural ceramics and Ceramic Matrix Composites (CMCs) are critical for next-generation aerospace and defense systems due to their exceptional high-temperature stability and strength. However, macroscopic failure in these materials inevitably originates at

the microstructural level. This project will develop and apply novel, high-resolution characterization approaches to fundamentally understand the mechanical response, load transfer, and damage evolution of individual microstructural constituents (distinct phases, grains, and interfaces) within complex ceramic architectures.

6. Research Classification/Restrictions: Research will be CUI

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

NOTE: Topics submitted to DAGSI must be approved for public release. Need PA Approval #