

Attachment 1 – DAGSI Research Topic Template

1. **Research Title:** Investigations of the Processing Challenges of Ceramic and Ceramic Matrix Composite Structures

2. **Individual Sponsor:**

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

Ceramic Processing/High Speed Flight/Additive Manufacturing (PhD)

4. **Objectives:** Developing new and maturing existing processing techniques for ceramics and ceramic matrix composites (CMC) will be key to advance Air Force high-speed flight technologies and is the primary objective of the proposed research.

5. **Description:**

Fabrication of ceramic-based parts that can exhibit high effective strains during flight will require the use of additive manufacturing (AM) techniques that have not been developed for high-temperature materials such as ultra-high temperature borides and carbides. Development of manufacturing methods for low-cost CMCs and ultra-high temperature ceramic matrix composites is also critical for advancing propulsion-based technologies. Current ceramic processing strategies to include slip casting, additive manufacturing including material extrusion (MEX) and vat photopolymerization (VPP), and more conventional composite lay-up methods, are of interest. Each technique has processing challenges that need to be investigated. For example, the organic binders used for MEX and VPP often cause defects upon thermal debinding; these defects ultimately cause cracks and/or delamination in sintered parts, greatly affecting mechanical properties. In VPP, interactions of light with highly absorbing boride powders can reduce cure thickness. Strategies are required to make these powders more reflective to facilitate AM. In summary, there are numerous processing challenges to advance ceramic and CMC processing for Air Force applications. The candidate will work with the sponsor to design a research program of impact to the Air Force to address fabrication of ceramics and/or CMCs.

6. **Research Classification/Restrictions:** Research will be unclassified.

7. **Eligible Research Institutions:** Candidates with backgrounds in various engineering disciplines (e.g. materials, mechanical, chemical, etc.) and science disciplines (e.g. chemistry and physics) are encouraged to contact the sponsor.

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