

## AFRL CALL FOR RESEARCH

**1. Research Title:** *High Temperature Sensors for use in Scramjet Engine Control*

**2. Individual Sponsor:**

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**3. Academic Area/Field and Education Level:** Materials Engineering, Electrical Engineering, Mechanical Engineering, Aerospace Engineering (MS and/or Ph.D. level)

**4. Objectives:** The proposed thesis topic aims to develop sensors for use in a scramjet engine control system. The installed sensors will provide a control system with inputs that will increase engine operability limits and maximize engine performance.

**5. Description:** An effective control system is dependent on the quality and quantity of inputs it receives in order to make appropriate decisions. The thermal operating environment within a scramjet combustor is extremely harsh with temperatures on the order of 3000°F. However, in order to implement an engine control system, it will be necessary to make reliable measurements of pressure, temperature, heat flux, and skin friction in such a harsh environment. In addition, some transient events (e.g., ignition, flame blowout, and engine unstart) within a scramjet combustor occur on the order of 1 kHz. Therefore it would also be desirable for the sensor to have a frequency response of that order or higher. Another area of consideration is the durability of the sensor. In the near term, scramjet engines are expected to operate for 10-15 minutes, but longer-term goals include reusable combined-cycle vehicles that will operate in similar fashion to the jet aircraft of today. The DAGSI masters or PhD student and faculty member will utilize the Aerospace Propulsion Division's (AFRL/RZA) two direct-connect supersonic combustion facilities for the experimental research. These facilities are capable of simulating vehicle flight conditions over the Mach 4-8 range and would provide a realistic environment for sensor evaluation. While initial demonstration of the developed sensors would occur in ground testing, the longer term goal would be to have a flight capable sensor for use in future scramjet engine/vehicle flight tests (this would preclude the use of fluid-cooled devices as they are not practical in flight).

**6. Research Classification/Restrictions:** U.S. Citizens only. Most aspects of this research fall under the 6.1 basic research classification. However, some aspects, in particular those dealing with specific engine configurations and performance parameters, are FOUO with ITAR restrictions.

**7. Interest in Summer USAFA Cadet: No**

**8. Eligible Research Institutions:**

Universities (DAGSI)                       AFIT                       USAFA