Research Development Fund – Fall 2022 Application Template
Submission Deadline: ***12:00PM CDT Monday – October 10, 2022,*** **to rdf@tamu.edu**

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Application Title:

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Key Participating Units: COS (CHEM, GEOL); COE (AERO, CHEN, CVEN, MEEN, MSEN)

RDF Amount Requested ($): **$378,222**

Executive Summary

This RDF proposal supports a suite of high-temperature thermophysical characterization tools which are fundamental to understanding the behavior of matter at high temperatures. High temperature behavior is a common thread which unites research in the earth sciences (T_{mantle} from 1000 to 3700 °C), in new high pressure and high temperature metastable states of matter, and in the applied engineering sciences (e.g., $T_{turbine\ blades}$ >1200 °C; $T_{leading\ edge}$ >2000 °C). This RDF proposal addresses a present lack of user facility capabilities to probe this important regime.

This proposal will support the acquisition of (1) high temperature calorimeter (room temperature to 2000 °C) to measure heat capacity, enthalpies of transformations or reaction, and (1) high temperature dilatometer (room temperature to 2000 °C) to measure thermal expansion coefficient, which can be used to calculate thermal expansion stress at different temperatures. Recent investments at TAMU (including at MCF, Soft Matter facility, X-ray lab) have significantly advanced our capabilities to test different classes of materials and materials properties over different environmental conditions. However, high temperature characterization (>1000 °C) remains entirely lacking at present – a shortcoming that limits our ability to compete for funding (e.g., high temperature aerospace materials under University Center for Applied Hypersonics, high temperature geophysics under NSF/GEO/EAR). As an example, the highest temperature calorimeters available on campus are limited to operating <700 °C, limiting the ability to probe states at higher temperatures.

This system will primarily be utilized within TAMU/College of Science (COS; including CHEM, GEOL) and TEES/College of Engineering units (COE; AERO, CHEN, MEEN, MSEN), but also may find application within Agrilife (e.g., pyrolysis processes of agriculture products). The research portfolios that will be impacted span the breadth of basic fundamental physical sciences (NSF/DMR, DOE/BES), applied sciences (NSF/ENG, NASA, DARPA, ARPA-E, other DoD), and commercial partnerships (Boeing, Northrop Grumman). Critically, the equipment will complement current major Texas A&M System cooperative research centers (e.g., hypersonics Bush Combat Development Center) and externally supported research centers (both current: DOE Energy Frontier Research Center, and planned: NSF Center for Chemical Innovation).

The requested instrument will be placed in in the Materials Development and Characterization Center (MDC^2), that is sustainable, self-supported user facility housing various materials processing and characterization equipment. Placement in the MDC^2 ensures 1) that an existing infrastructure is already in place to allow easy access and training of internal and external users, 2) an existing avenue for maintenance of this tool, and 3) unifies low-temperature and high-temperature thermal analysis capabilities.