



Minority University Research and Education Project (MUREP)

Institution: California State University, Fullerton

Award Name: MUREP Institutional Research Opportunity (MIRO) - Group 8

Award Number: 80NSSC24M0173

Title: SpaceIgnite Center for Advanced Research-Education in Combustion (SPARC Center)

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Summary: The proposed SPARC Center supports faculty and students at California State University Fullerton (CSUF), a Hispanic Serving Institution and an Asian American and Native American Pacific Islander Serving Institution, to participate in high-pressure combustion and supercritical oxidation research that supports future space exploration missions. The SPARC Center has four overarching goals that align with the MIRO goals and objectives. (1) Develop aerospace research programs that align with NASA's research priorities and missions and explore the applications of supercritical oxidation systems in space explorations. (2) Partner with R1 research institutions and expand collaborations with NASA and industry partners. (3) Promote faculty and students' participation in NASA-related research through NASA-funded projects and curriculum developments. (4) Build a more diverse NASA workforce by increasing the number of minority students who successfully complete degrees in STEM and NASA-relevant fields and enhancing their educational experience through a newly upgraded curriculum at CSUF and internships at NASA.

A diverse proposal team has been assembled to achieve these goals of the SPARC Center. The team includes investigators from Clemson University (in a NASA EPSCoR state) and the University of Washington (UW) to help CSUF build the research capability in supercritical combustion and oxidation to support future space exploration missions. The proposed research will involve a comprehensive ground-based program to study high-pressure combustion of liquid fuels, transcritical/supercritical fluid injection, and supercritical oxidation using both experimental and numerical tools. Specific research aims of the SPARC Center are to (1) Examine the liquid fuel injection processes at transcritical and supercritical conditions via numerical simulations; (2) Investigate the high-pressure combustion dynamics of sustainable aviation fuels; and (3) Design efficient mixing for the Supercritical Water Oxidation (SCWO) reactor and conduct SWCO experiments for wastewater reclamation. The results obtained will provide unique insights into the physics of liquid fuel combustion for advanced engine designs and the use of SCWO as an effective technology for reclaiming water for future space missions.

The proposed research in transcritical and supercritical combustion is aligned with the NASA Science Missions Directorate. It is consistent with NASA's research interests in the Combustion Science area and NASA Glenn Research Center's (GRC) research priorities. Therefore, the SPARC Center will partner with NASA GRC by supporting CSUF students' internships at GRC so that they can use the Zero Gravity Facility, SCWO reactors, and other lab facilities at GRC. CSUF faculty will build a connection with NASA GRC for long-term collaborations, carry out research of interest to SMD, be ready to lead proposals to NASA and other agencies, and build a sustained pipeline for a diverse workforce in NASA-related fields.

The proposed educational activities also include establishing a new "focus area" in Aerospace Engineering for the Bachelor of Science in Mechanical Engineering (BSME) program at CSUF through new curriculum development. Three new courses in aerospace will be developed to provide a solid foundation for CSUF students to engage in NASA research and prepare them for a successful career in aerospace. Moreover, the SPARC Center will collaborate with Santiago Canyon College to engage community college students in research and encourage them to transfer to the BSME program at CSUF. The SPARC Center will also develop the pipelines for students to pursue doctorates at Clemson, UW, or other top-tier research institutions. These efforts will help to increase the number of minority students who have a STEM degree, increase their interest in pursuing a career at NASA or in the aerospace industry, and diversify the workforce for NASA and the nation.