| | | | |
|---|---|---|---|
| **Fiscal Year:** | FY 2018 | **Task Last Updated:** | FY 01/10/2018 |
| **PI Name:** | Takahashi, Fumiaki D.Eng. | | |
| **Project Title:** | Structure and Stabilization of Laminar Jet Diffusion Flames | | |
| **Division Name:** | Physical Sciences | | |
| **Program/Discipline:** | | | |
| **Program/Discipline--Element/Subdiscipline:** | COMBUSTION SCIENCE--Combustion science | | |
| **Joint Agency Name:** | | **TechPort:** | No |
| **Human Research Program Elements:** | None | | |
| **Human Research Program Risks:** | None | | |
| **Space Biology Element:** | None | | |
| **Space Biology Cross-Element Discipline:** | None | | |
| **Space Biology Special Category:** | None | | |
| **PI Email:** | [fxt13@case.edu](mailto:fxt13@case.edu) | **Fax:** | FY |
| **PI Organization Type:** | UNIVERSITY | **Phone:** | 440-520-5939 |
| **Organization Name:** | Case Western Reserve University | | |
| **PI Address 1:** | Mechanical and Aerospace Engineering | | |
| **PI Address 2:** | 10900 Euclid Ave | | |
| **PI Web Page:** | | | |
| **City:** | Cleveland | **State:** | OH |
| **Zip Code:** | 44106-1712 | **Congressional District:** | 11 |
| **Comments:** | NOTE: Also affiliated with NASA Glenn Research Center | | |
| **Project Type:** | GROUND,Physical Sciences Informatics (PSI) | **Solicitation / Funding Source:** | 2015-16 Physical Sciences NNH15ZTT001N-15PSI-C: Use of the NASA Physical Sciences Informatics System – Appendix C |
| **Start Date:** | 12/13/2017 | **End Date:** | 12/12/2019 |
| **No. of Post Docs:** | | **No. of PhD Degrees:** | |
| **No. of PhD Candidates:** | | **No. of Master' Degrees:** | |
| **No. of Master's Candidates:** | | **No. of Bachelor's Degrees:** | |
| **No. of Bachelor's Candidates:** | | **Monitoring Center:** | NASA GRC |
| **Contact Monitor:** | Stocker, Dennis P | **Contact Phone:** | 216-433-2166 |
| **Contact Email:** | [dennis.p.stocker@nasa.gov](mailto:dennis.p.stocker@nasa.gov) | | |
| **Flight Program:** | | | |
| **Flight Assignment:** | | | |
| **Key Personnel Changes/Previous PI:** | | | |
| **COI Name (Institution):** | | | |
| **Grant/Contract No.:** | 80NSSC18M0040 | | |
| **Performance Goal No.:** | | | |
| **Performance Goal Text:** | | | |
| | In early 2012, the Structure and Liftoff In Combustion Experiment (SLICE) was conducted in the Microgravity Science Glovebox (MSG) aboard the International Space Station (ISS). Methane, ethylene, or a selected nitrogen dilution of each fuel issuing from a burner tube in coflowing air was ignited to form a laminar diffusion flame. Flow conditions and the finite-rate combustion chemistry caused the flame to detach from the burner rim and lift to a new stabilizing position downstream. The structure of the flame was characterized and the liftoff velocity limits were determined as a function of the fuel and burner diameter. The flame temperature, soot, and CH* radical concentrations were measured and compared with computation. Although the lifted flame far from the burner (~10 cm) might be stabilized with a triple-flame structure, i.e., a stoichiometric diffusion flame base with fuel lean and rich premixed branches, the stabilizing and lifting mechanisms of burner-rim-attached flames were still largely left unstudied. | | |

| | |
|---|---|
| **Task Description:** | The global objective of the proposed research is to elucidate the diffusion flame stabilizing and lifting mechanisms. The specific aims include: (1) analyze thoroughly the SLICE liftoff velocity limit data to extract general trends, (2) conduct ground-based liftoff experiments using C1 – C4 hydrocarbons to study fuel effects, (3) perform computation with full chemistry to reveal the flame structure and flame-flow interactions, leading to the liftoff conditions. The overall merit of the proposed research is fundamental contributions to combustion science and NASA's microgravity combustion research, through the effective use of underutilized SLICE data on the liftoff limits and the rigorous validation of the numerical methods, including reaction mechanisms, soot formation, and radiation models.<br><br>The Principal Investigator (PI) has more than 20 years of experience and knowledge in microgravity combustion research and has served as a co-Investigator for the SLICE project. Case Western Reserve University has recently expanded the Fire and Combustion Laboratories, equipped with various fire testing instruments, and the computation will be performed using the Case High Performance Computing Cluster. If successful, the proposed research will give a significant impact on the research area of flame stabilization, which has been one of major subjects of interest since the early days of modern combustion research, started several decades ago. As a result of recent advances in flame diagnostic techniques and numerical predictive capabilities, including comprehensive chemical kinetics, it is now feasible to elucidate complex flame-flow interacting phenomena such as flame stabilization. A federal financial assistance is needed to accomplish such an important scientific goal. |
| **Rationale for HRP Directed Research:** | |
| **Research Impact/Earth Benefits:** | If successful, the proposed research will give a significant impact on the research area of flame stabilization, which has been one of major subjects of interest since the early days of modern combustion research, started several decades ago. As a result of recent advances in flame diagnostic techniques and numerical predictive capabilities, including comprehensive chemical kinetics, it is now feasible to elucidate complex flame-flow interacting phenomena such as flame stabilization. |
| **Task Progress:** | New project for FY2018. |
| **Bibliography Type:** | Description: (Last Updated: 04/14/2021) |