Fiscal Year:	FY 2017	**Task Last Updated:**	FY 03/08/2017
PI Name:	Dunn-Rankin, Derek Ph.D.		
Project Title:	ACME: EFIELD – Electric Field Effects On Laminar 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:	ddunnran@uci.edu	**Fax:**	FY
PI Organization Type:	UNIVERSITY	**Phone:**	949-824-8745
Organization Name:	University of California - Irvine		
PI Address 1:	Department of Mechanical & Aerospace Engineering		
PI Address 2:	4200 Engineering Gateway Bldg, EG3224		
PI Web Page:			
City:	Irvine	**State:**	CA
Zip Code:	92697-3975	**Congressional District:**	48
Comments:			
Project Type:	FLIGHT	**Solicitation / Funding Source:**	NOT AVAILABLE
Start Date:	11/18/2016	**End Date:**	11/17/2019
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		
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Karnani, Sunny Ph.D. (Clearsign Combustion Incorporated)		
Grant/Contract No.:	NNX17AC51A		
Performance Goal No.:			
Performance Goal Text:			

NOTE: This is a successor agreement to "Electric Field Control of Flames," grant NNX11AP42A, per D. Stocker, NASA Glenn Research Center.
This project at the University of California, Irvine explores the use of large electric fields in combustion for the purpose of improving the performance of energy conversion systems. As an actuator, electric fields can affect flame stability and soot formation, while, as a sensing device, the electrical response at saturation is an inherent flame characteristic. In addition to preparing for the proposed ACME E-FIELD experiments aboard the International Space Station (ISS), we have performed an evaluation of an experimental method of measuring ion number density in a flame using a Langmuir probe, studied the dynamic interaction between the flame and chemi-ions, analyzed the source of increased saturation ion currents found in I-V curves, used electric fields to control flames impinging on a surface, and begun to develop computational models to predict chemi-ion concentrations in flames. This report summarizes recent findings. Specific activities include:

Task Description:	1.) A study on the dynamic interaction between the flame and the electrical body force created by a flux of chem-ions. This was done in several ways, by analyzing the dynamic response of the gaseous flow field in response to a sudden application of an electric field, by comparing transient flame behavior using a high speed camera and the transient ion current collected when an electric field is turned on. 2.) A study of the interaction between the flame and the DC electric fields. This was done by studying the flame geometry to varies steady electric field strengths and analyzing I-V curves for different burner geometries. 3.) A study to construct a framework and approach for building computational models to predict ion concentrations in the flame, including the effects of ion driven winds. Different burner geometries were tested. Different ion chemistry models were used to test the current level of understanding of how ions are produced in the flames. Understanding electric field interactions with flames is central to combustion control, particularly in situations near limit operation of the flame where small effects are amplified dramatically. Electric fields have been shown to modify burning rates as well as to enhance and reduce flame propagation even to the point of flame extinguishment. Our experiments provide a unique ability to make simultaneous measurements of both physical and electrical properties of flames.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The control of combustion has the potential to improve efficiency and reduce emissions from burning fuels. Since high power density often requires combustion, these improvements will be important no matter what the fuel source. Electric fields acting on flames have the potential to aid in combustion control. In addition, electrical properties of flames can identify poor performing boiler flames that release poisonous carbon monoxide. Our studies show that a flame's electric signature can capture incipient quenching before dangerous emissions result. Understanding the links between electrical character and flame behavior may allow improved sensing of poor performing combustion systems.
Task Progress:	New project for FY2017. Continuation of "Electric Field Control of Flames," grant NNX11AP42A. See that project for previous reporting.
Bibliography Type:	Description: (Last Updated: 02/12/2024)