

AD-A187 646

STUDIES OF FLUORINE COMBUSTION(U) EMORY UNIV ATLANTA GA
M KAUFMAN 03 SEP 87 AFOSR-TR-87-1923 AFOSR-86-0220

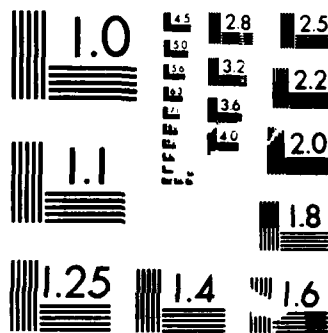
1/1

UNCLASSIFIED

F/G 21/2

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

AD-A187 646

REPORT DOCUMENTATION PAGE

DTIC FILE COPY

1a. SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS				
2a. SECURITY CLASSIFICATION AUTHORITY DTIC SELECTED JAN 07 1988			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited				
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE			5. MONITORING ORGANIZATION REPORT NUMBER(S) AFOSR-TR- 87-1923				
4. PERFORMING ORGANIZATION REPORT NUMBER(S)			6a. NAME OF PERFORMING ORGANIZATION Emory University			6b. OFFICE SYMBOL (// applicable)	7a. NAME OF MONITORING ORGANIZATION AFOSR/NA
6c. ADDRESS (City, State and ZIP Code) Atlanta, GA 30322			7b. ADDRESS (City, State and ZIP Code) Building 410, Bolling AFB DC 20332-6448				
8a. NAME OF FUNDING/SPONSORING ORGANIZATION AFOSR/NA		8b. OFFICE SYMBOL (// applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER AFOSR - 86-0220				
8c. ADDRESS (City, State and ZIP Code) Building 410, Bolling AFB DC 20332-6448			10. SOURCE OF FUNDING NOS.				
			PROGRAM ELEMENT NO. 61102F	PROJECT NO. 2917	TASK NO. A1	WORK UNIT NO.	
11. TITLE (Include Security Classification) Studies of Fluorine Combustion							
12. PERSONAL AUTHOR(S) Myron Kaufman							
13a. TYPE OF REPORT final		13b. TIME COVERED FROM 1-8-86 TO 7-31/87		14. DATE OF REPORT (Yr., Mo., Day) 1987, Sept. 3		15. PAGE COUNT 3	
16. SUPPLEMENTARY NOTATION							
17. CCSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)				
FIELD	GROUP	SUB. GR.	laser, fluorine, combustion ←				
19. ABSTRACT (Continue on reverse if necessary and identify by block number) This program has funded the purchase of a Coherent Inc. CW ring dye laser with intracavity doubling capability exacted by an 18 watt Ar ion laser. This laser system will be employed as a sensitive and specific probe for intermediates in the combustion of various fuels in F ₂ . Because of their extreme exothermicity, many such reactions have considerable potential for propulsion applications.							
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS <input type="checkbox"/>			21. ABSTRACT SECURITY CLASSIFICATION Unclassified				
22a. NAME OF RESPONSIBLE INDIVIDUAL Mitat A Birkan			22b. TELEPHONE NUMBER (Include Area Code) (202) 767-4938		22c. OFFICE SYMBOL AFOSR/NA		

The following items of equipment have been purchased and installed in our laboratory:

	<u>Cost^a</u>
1. Optical Table, Newport Corp. model RS-410-8	\$ 5,150.
2. Support System, Newport Corp. model NN4-22	860.
Items 3-7 from Coherent Inc.	
3. I-100-19 Innova Argon Ion Laser	47,500.
4. CR-699-21 Ring Dye Laser	48,000.
5. 7500-05 Frequency Doubler	12,000.
6. 304 Modulation System	1,590.
7. Doubling Optics (extra ranges)	3,320.
8. Microvac Vacuum Pump, Stokes model 21GV4D	4,800. ^b
9. laser dye assortment, Exciton Co.	686. ^b
10. fluorine regulator and purge, Matheson Corp.	815. ^b
11. pump connectors, Alcatel	32.
12. miscellaneous fittings, Georgia V&F	115.
13. windows, Harshaw	<u>85.</u>
Total	124,953.

Notes

a) quoted prices; actual costs may differ slightly due to shipping costs, see accounting report

b) items 8,9 and 10 discussed in letter of 7/21/87 to program manager

In addition, we will receive as donations from Coherent Inc. a LiIO₃ doubling crystal with optics (model 7501-01, price \$5000) and a rotation assembly for this crystal (model 7502/3, price \$1000).

Technical

The purchased state-of-the-art laser system provides a minimum of 10 mW of cw laser power over the wave length range of 267-1000 nm. Linewidths of 1 MHz can be achieved with this system. Because of the late delivery of the laser system, no results can yet be reported with this equipment.

Our experiments will proceed in the following order:

1) A gas-phase cell for laser-induced fluorescence (LIF) measurements has been constructed and will be used to record the LIF spectrum of I₂. The high density of sharp lines in this spectrum will be ideal for accurate wave length calibration of the laser throughout its spectrum.

2) The first combustion intermediate that we will study will be the CH radical. The A state of this radical can be accessed with coumarin dye. In order to familiarize ourself with the LIF spectrum of this radical, it will first be generated in a low-pressure flow system. The radical will be produced from CHBr₃, either by reaction with hydrogen atoms or by electric discharge or photochemical decomposition.

3) The LIF spectrum of CH will then be used to monitor this radical in low-pressure F₂-CH₄ premixed flames. One objective of these studies will be to attempt to correlate the concentration of ground state CH radicals with emission from excited states of CH in this flame. One mechanism proposed for CH emission in oxygen-free combustion involves transfer of H+F recombination energy to CH, and this mechanism would predict such a correlation.

4) Laser scattering will also be employed to monitor the onset of soot formation in F₂-CH₄ and F₂-C₂H₂ flames. One model of soot formation in combustion involves nucleation on small chemically formed ions.¹ We have found that in F₂-hydrocarbon combustion, chemiions can be completely eliminated by removing oxygen impurity.² Comparison of the

onset of soot formation in flames burning in purified and oxygen-containing fluorine thus provides a simple method of testing for the importance of the proposed model.

5) Under a range of operating parameters F₂-CH₄ flames burn with oscillations or pulses, rather than as steady flames.³ The chemical mechanism responsible for these phenomena are presently unclear, since unlike oxygen-supported combustion, opportunities for alternative pathways of reaction are much more restricted with univalent fluorine than with divalent oxygen. By probing the time course of the concentration of intermediates, such as CH, in oscillating and pulsed F₂-supported combustion, we will attempt to derive and test models for these phenomena.

Emory University has provided us with a \$10,000 account for use in connection with our project. In addition, Emory is granting the principal investigator a one-semester leave from teaching in order to facilitate the development of our laser methods for studying fluorine-based combustion. In preparation for our experimental program, the principal investigator attended the Gordon Research Conference on Physics and Chemistry of Laser Diagnostics of Combustion, at Plymouth, New Hampshire, during July 13-17.

References

- 1) E. F. Calcotte, "Mechanisms of Soot Nucleation in Flames -- A Critical Review", Comb. Flame, 42, 215 (1981)
- 2) D. Jones and M. Kaufman, "Combustion of Hydrocarbons in Purified Fluorine", Comb. Flame, 67, 217 (1987)
- 3) M. Kaufman, annual report AFOSR Grant 84-0196, Aug. 31, 1985



A-1

END

FEB.

1988

DTIC