

UNCLASSIFIED

AD NUMBER	
AD508353	
CLASSIFICATION CHANGES	
TO:	unclassified
FROM:	confidential
LIMITATION CHANGES	
TO:	Approved for public release, distribution unlimited
FROM:	Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; OCT 1969. Other requests shall be referred to Air Force Propulsion Lab., Edwards AFB, CA.
AUTHORITY	
31 Oct 1981, DoDD 5200.10; AFRPL ltr, 13 Feb 1986	

THIS PAGE IS UNCLASSIFIED

AD 508 353

AUTHORITY:

AFRPL

11r. 13 Feb 86



THIS REPORT HAS BEEN DELIMITED
AND CLEARED FOR PUBLIC RELEASE
UNDER DOD DIRECTIVE 5200.20 AND
NO RESTRICTIONS ARE IMPOSED UPON
ITS USE AND DISCLOSURE.

DISTRIBUTION STATEMENT A

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED.

SECURITY

MARKING

The classified or limited status of this report applies to each page, unless otherwise marked.
Separate page printouts MUST be marked accordingly.

THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, U.S.C., SECTIONS 793 AND 794. THE TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U.S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

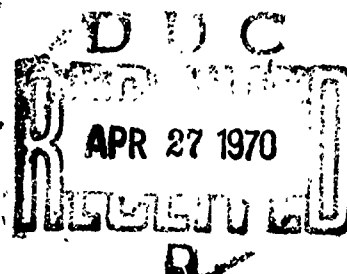
AFRPL-TR-69-219

CONFIDENTIAL

**(U) THE SYNTHESIS OF NEW IONIC
INTERHALOGEN OXIDIZERS**

F. Q. ROBERTO

OCTOBER 1969



TECHNICAL REPORT AFRPL-TR-69-219

IN ADDITION TO SECURITY REQUIREMENTS WHICH MUST BE MET, THIS DOCUMENT IS SUBJECT TO SPECIAL EXPORT CONTROLS AND EACH TRANSMITTAL TO FOREIGN GOVERNMENTS OR FOREIGN NATIONALS MAY BE MADE ONLY WITH PRIOR APPROVAL OF AFRPL (RPOR-STINFO), EDWARDS, CALIFORNIA 93523.

**AIR FORCE ROCKET PROPULSION LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
EDWARDS, CALIFORNIA**

AD508353

THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, U.S.C., SECTION 793 AND 794, THE TRANSMISSION OF WHICH IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

CONFIDENTIAL

DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS.
DOD DIR 5200.10

CONFIDENTIAL

NOTICES

When U.S. Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise, or in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

CONFIDENTIAL

(This page is unclassified)

CONFIDENTIAL

AFRPL-TR-69-219

THE SYNTHESIS OF NEW IONIC
INTERHALOGEN OXIDIZERS (U)

Francisco Q. Roberto

In addition to security requirements which must be met, this document is subject to special export controls and each transmittal to foreign governments or foreign nationals may be made only with prior approval of AFRPL (RPOR-STINFO), Edwards, California 93523.

DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS.
DOD DIR 5200.10

CONFIDENTIAL

THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, U.S.C., SECTION 793 AND 794, THE TRANSMISSION OF WHICH IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

CONFIDENTIAL

FOREWORD

(U) This is a phase report of work conducted at the Air Force Rocket Propulsion Laboratory to determine the feasibility of producing interhalogen high-energy liquid oxidizers. This work was accomplished under Project 314801ACL during the period of July 1968 through July 1969 by Dr. Francisco Q. Roberto, Task Scientist. The author wishes to acknowledge the valuable technical discussions and support furnished by Dr. Claude Merrill, Project Scientist; Dr. Charles Bock for X-ray diffraction work and to Mr. John H. Leahy for the analysis of this hazardous and very reactive material. The author also wishes to acknowledge Dr. George Begun, Oak Ridge National Laboratory for running the Raman spectral study.

(U) This report has been reviewed and approved.

NORMAN J. VANDER HYDE
Chief, Solid Propellant Branch
Propellant Division
Air Force Rocket Propulsion Laboratory

CONFIDENTIAL

(This page is unclassified)

CONFIDENTIAL

CONFIDENTIAL ABSTRACT

(C) The synthesis of hexafluorochloronium (VII) hexafluoroplatinate (V), $\text{ClF}_6^+\text{PtF}_6^-$, from the reaction of chlorine pentafluoride and platinum hexafluoride is described as an oxidation-reduction reaction. This has been confirmed by elemental analyses, infrared and Raman Spectroscopy, X-ray powder diffraction and displacement reaction with trifluorochlorine oxide. This is the first example of a perfluorinated heptavalent chlorine cation. The compound, $\text{ClF}_6^+\text{PtF}_6^-$, has been indexed as having a cubic structure based on preliminary X-ray powder pattern.

CONFIDENTIAL

TABLE OF CONTENTS

<u>Section</u>		<u>Page</u>
(U) I	INTRODUCTION	1
(U) II	EXPERIMENTAL PROCEDURES	2
	A. (U) Equipment	2
	B. (U) Materials	2
	C. (U) Analysis	3
	D. (C) Reaction of Platinum Hexafluoride with Chlorine Pentafluoride	4
	E. (C) Reaction with ClF_3O	5
(U) III	RESULTS AND DISCUSSION	7
(U)	BIBLIOGRAPHY	12
(U)	DISTRIBUTION	15
(U)	FORM 1473	21

ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
(C) 1	Infrared Spectrum of $\text{ClF}_6^+\text{PtF}_6^-$ and $\text{ClF}_4^+\text{PtF}_6^-$. . .	10

<u>Table</u>		<u>Page</u>
(C) 1	X-Ray Powder Data for $\text{ClF}_6^+\text{PtF}_6^-$	11

CONFIDENTIAL

SECTION I

INTRODUCTION

(U) Reactions of platinum hexafluoride with other oxidizing agents have been studied by several investigators.⁽¹⁻⁶⁾ With chlorine trifluoride, difluorochloronium (III) hexafluoroplatinate (V) (ClF_2PtF_6), and chlorine pentafluoride⁽⁷⁾ are produced.⁽⁶⁾ Gortsema and Toeniskoetter⁽⁶⁾ also attempted to react platinum hexafluoride with chlorine pentafluoride; the only product observed, in addition to the reactant, was a yellow solid believed to be ClF_2PtF_6 (it was assumed that it resulted from the decomposition of chlorine pentafluoride into chlorine trifluoride and subsequent reaction of chlorine trifluoride with platinum hexafluoride). Recent studies of the same reaction have shown that tetrafluorochloronium (V) hexafluoroplatinate (V) was produced.⁽⁸⁾ Other salts of tetrafluorochloronium ion have been reported recently.⁽⁹⁾

(C) Studies in this laboratory of platinum hexafluoride with chlorine pentafluoride have shown that in an excess of chlorine pentafluoride using a sapphire reactor, a solid product, believed to be hexafluorochloronium (VII) hexafluoroplatinate (V) (ClF_6PtF_6), was obtained. The cation ClF_6^+ has been reported previously.^(10, 11) However, most of the evidence was based on infrared data and more recent studies have disputed its synthesis.⁽¹²⁾ The solid produced in this laboratory is markedly different from those reported⁽¹⁰⁻¹²⁾ and new data are presented for the synthesis of ClF_6^+ in this laboratory.

CONFIDENTIAL

CONFIDENTIAL

SECTION II

EXPERIMENTAL PROCEDURES

A. EQUIPMENT

(U) The vacuum system used in this work consisted of a nickel manifold constructed from 1/4-inch nickel pipe to which a number of subsystems were attached. These were: (1) a multipurpose line for handling, measuring, and transferring reactants; (2) a line for purifying and storing fluorine; and (3) a similar line for purifying halogen fluorides. All valves (Hoke TM 413 monel diaphragm valves with metal seats) were silver-soldered to the manifold outlets. Pressure measurements were made with the Wallace and Tiernan gage, Model FA 145, accurate to 0.2 torr. Volumes were calibrated using pure helium and nickel bulbs of known volume.

(U) The vacuum system and sapphire reactors were passivated with fluorine at 300° using a heat gun. Passivation was considered complete when pressure at ambient temperature was identical before and after heating to 300°. Before each run, the whole system was passivated with chlorine pentafluoride followed by a final passivation with platinum hexafluoride.

B. MATERIALS

(U) Platinum hexafluoride was obtained from Ozark-Mahoning Company, Tulsa, Oklahoma. The material was further purified by low-temperature distillation according to the procedure described.⁽¹⁾

CONFIDENTIAL

The infrared spectrum⁽¹³⁾ and vapor pressure of the pure material agreed well with the published values.

(C) Chlorine pentafluoride and trifluorochlorine oxide, ClF_3O ,⁽¹²⁾ were obtained from Rocketdyne, a Division of North American Aviation, Canoga Park, California. The material was used without further purification.

C. ANALYSIS

(U) The platinum compounds were transferred into a 50-ml quartz reactor that had been previously weighed in the dry box and purged with dry nitrogen. The reactor was then connected to the vacuum system to remove the nitrogen and reweighed. The sample was frozen at -196° and 5-10 ml of double-distilled water was transferred to the sample. Immediate reaction was accompanied by a flash when vapor initially came into contact with the sample. The sample was warmed to ambient temperature by removing the liquid nitrogen trap. After half an hour at ambient temperature, the solution was refrozen to -196° and 5-10 ml of hydrazine was transferred to it. The solution was again warmed to ambient temperature. The platinum solids formed by hydrolysis and reduction were filtered off; they were redissolved with aqua regia to convert the platinum-containing materials to chloroplatinic acid. The solution was diluted with water, reduced with sodium formate,⁽¹⁴⁾ and the finely divided platinum metal was filtered, dried, and weighed. After additional dilution, aliquots of the stock solution were analyzed for chlorine and fluorine. Chloride ions were determined by anodic chronopotentiometry using a silver electrode.

CONFIDENTIAL

CONFIDENTIAL

Fluoride ion was determined potentiometrically with an Orion fluoride ion electrode.⁽¹⁵⁾ The above methods were checked with standard samples.

(U) X-ray diffraction studies were carried out using the powder techniques with samples sealed in 0.3-mm thin-wall quartz capillary tubes. The tubes were previously flamed in a vacuum line to remove moisture. Samples were loaded in a dry box, flushed with dry nitrogen, sealed with Kel-F grease, and placed in a 5.73-cm Debye-Sherrer camera. Measurements were made using copper $K\alpha_1$ radiation with a nickel filter. Exposure times varied from 1/2 hour to 4 hours. Intensities were estimated visually.

(U) Infrared spectra were obtained with Beckman IR-5A and Perkin-Elmer 337 spectrophotometers. Gaseous spectra were obtained using a 10-cm nickel cell equipped with silver chloride windows. Spectra were obtained on the solid pressed between chloride windows of the nickel infrared cell. All operations were carried out in a dry box.

D. REACTION OF PLATINUM HEXAFLUORIDE WITH CHLORINE PENTAFLUORIDE

(C) In a typical reaction, 1.26 mmole (0.390 grams) of platinum hexafluoride, and 3.78 mmole (0.491 grams) of chlorine pentafluoride were condensed at -196° into an evacuated, prepassivated 7-cc sapphire reactor. The reaction mixture was slowly warmed to ambient temperature. The mixture was left exposed to light at $22-23^\circ$ for a period of 8 days. The reaction was monitored by the disappearance of PtF_6 (red gas). As time progressed, the red-brown solid phase became lighter. After 8 days,

CONFIDENTIAL

CONFIDENTIAL

the solid turned to the bright yellow color of the ClF_xPtF_6 salt. The reactor was cooled to -196 and found to contain no noncondensable gas. The gaseous mixture was found to contain only ClF_5 .⁽¹⁶⁾ The excess ClF_5 was removed under vacuum giving a bright orange-yellow solid with no vapor pressure at room temperature. The weight of the solid product was 0.489 grams. The material was analyzed according to the procedure described.

(C) Anal. Calcd. for ClF_6PtF_6 : Pt, 42.56; F, 49.7; Cl, 7.73.
Found: Pt, 42.7; F, 47.2; Cl, 5.2.

(C) The infrared spectrum of the yellow solid was prepared in the dry box by pressing it between silver chloride windows. This is shown in Figure 1. The X-ray powder pattern of the solid is given in Table I.

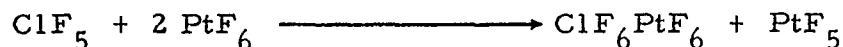
E. REACTION WITH ClF_3O

(C) In order to further characterize the ClF_xPtF_6 , excess ClF_3O was condensed on top of the solid of ClF_xPtF_6 at -196°C . The reactor was gradually warmed to -85°C using trike-liquid nitrogen slush. There was very little evidence of reaction at this temperature for 30 minutes. At -75°C , there was some reaction and the only volatile product found was ClF_5 and a trace of ClFO_2 . This reaction continued up to -35°C producing more ClF_5 . The total noncondensable (-196°C) was 5 mm after about 2 1/2 hours. The reaction was left overnight starting at -35°C and gradually warming to room temperature. The 40 millimeters of noncondensable at -196°C was identified (by mass spectral analysis and reaction

CONFIDENTIAL

with mercury) as fluorine. The ClF_5 formed was transferred and weighed by pumping on the reactor at -85°C . After all the volatile product was removed, the solid was weighed and subjected to infrared analyses. The infrared spectra was identical to the spectra of $\text{ClOF}_2\text{PtF}_6$ ⁽¹⁷⁾ previously obtained between the reactions of ClF_3O and PtF_6 .

(7) Based on the weight of fluorine, chlorine pentafluoride and $\text{ClF}_2\text{OPtF}_6$ produced, the ClF_xPtF_6 was calculated to contain a 50:50 mixture of ClF_4PtF_6 and ClF_6PtF_6 within experimental error. These results definitely established the presence of ClF_6^+ in the reaction product. The reaction to produce the heptavalent ClF_6^+ can be written as:



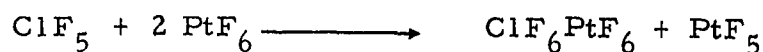
In excess ClF_5 , PtF_5 reacts with it to give ClF_4PtF_6 .

CONFIDENTIAL

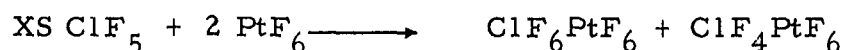
SECTION III

RESULTS AND DISCUSSION

(C) The solid product obtained in the reaction between platinum hexafluoride and chlorine pentafluoride using a sapphire reactor activated with light is believed to be ClF_6PtF_6 , in accordance with the equation

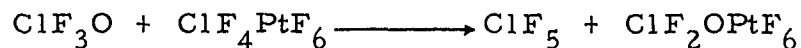


In excess ClF_5 , the reaction proceeds further to give ClF_4PtF_6 . The overall reaction in excess ClF_5 can be expressed as:



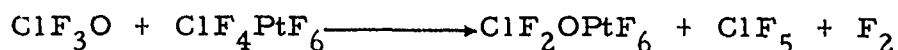
The reaction can be described as an oxidation-reduction where chlorine is oxidized to the heptavalent state forming an ionic solid $\text{ClF}_6^+\text{PtF}_6^-$ and PtF_5 . However, in an excess ClF_5 , PtF_5 is acting as a Lewis acid abstracting a fluoride ion from ClF_5 to give ClF_4PtF_6 .

(C) Further evidence for the synthesis of ClF_6PtF_6 was obtained from the reaction with trifluorochlorine oxide. The mass balance obtained from the reaction of $\text{ClF}_4\text{PtF}_6 \cdot \text{ClF}_6\text{PtF}_6$ with ClF_3O indicates that ClF_4PtF_6 reacted with ClF_3O at -75° to -35° according to the equation:

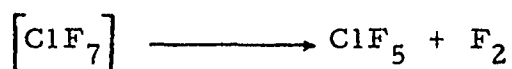
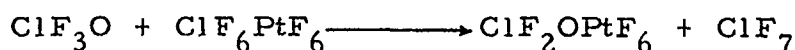


Above -35° , melting point of ClF_3O , ClF_6PtF_6 then reacted with ClF_3O in one of two ways:

CONFIDENTIAL



or



Since the only volatile products observed at ambient temperature were ClF_5 and fluorine, it is implied that ClF_7 formed and is unstable at this temperature or it is catalytically decomposed by $\text{ClF}_2\text{OPtF}_6$. From this study the composition of the mixture was deduced to be a 50:50 mixture of ClF_6PtF_6 and ClF_4PtF_6 based on the weight of fluorine, ClF_5 and $\text{ClF}_2\text{OPtF}_6$ produced from the above equation.

(C) The infrared spectrum of solid mixture $\text{ClF}_6\text{PtF}_6 + \text{ClF}_4\text{PtF}_6$ pressed between silver chloride plates consists of bands attributed to ClF_4PtF_6 and bands at 889, 875 and 540 cm^{-1} assigned to ClF_6^+ and the peak at 649 cm^{-1} attributed to the PtF_6^- absorption band. The 890, 875 and 540 cm^{-1} observed in the infrared were absent in the Raman spectrum as expected of an octahedral molecule. Since ClF_6^+ is isoelectronic with the octahedral, SF_6 , some similarity in their spectra is expected, except for slight frequency shifts due to their mass difference. The higher mass of the central atom in ClF_6^+ compared to SF_6 should cause a shift toward lower frequencies, as is indeed observed for the infrared active bands.

CONFIDENTIAL

Going from SF_6 (940 cm^{-1} , γ_3) to ClF_6^+ (890 cm^{-1} , γ_3), the shift is 50 cm^{-1} ; γ_4 for SF_6 at 615 cm^{-1} is shifted by 65 cm^{-1} in ClF_6^+ (540 cm^{-1}). These assignments are tentative and require further refinements.

(C) Of the six normal modes of vibration expected of an octahedral ion of the type XY_6 , ($A_{1g} + E_g + 2 F_{1u} + F_{2g} + F_{2u}$), only two of these modes ($2 F_{1u}$) will be infrared active and three will be Raman active (A_{1g} , E_g , and F_{2f}).

(C) The remaining F_{2u} mode is inactive in both infrared and Raman spectrum. However, since the octahedral PtF_6^- mode of vibrations have not been assigned, it is rather difficult to assign vibrations due to ClF_6^+ with any certainty. Since the only absorption band that we can assign with any degree of certainty to PtF_6^- is the absorption band at 645 cm^{-1} , the other absorption bands, in addition to 890, 875 and 540, at 521 and 313 cm^{-1} , may be attributed to ClF_6^+ .

(C) The X-ray powder pattern for ClF_6PtF_6 (after subtracting the lines due to ClF_4PtF_6) is relatively simple, indicating high symmetry. The high symmetry of the unit cell of ClF_6PtF_6 (probably cubic) seems reasonable since both ClF_6^+ and PtF_6^- have octahedral symmetries. The only other known compound of the $\text{XF}_6^+ \text{YF}_6^-$ structure is $\text{IF}_6^+\text{SbF}_6^-$.⁽¹⁸⁾ This salt has a high symmetry (face-centered cubic) and $\text{ClF}_6\text{PtF}_6^-$ is expected to exhibit similar structural symmetry.

CONFIDENTIAL

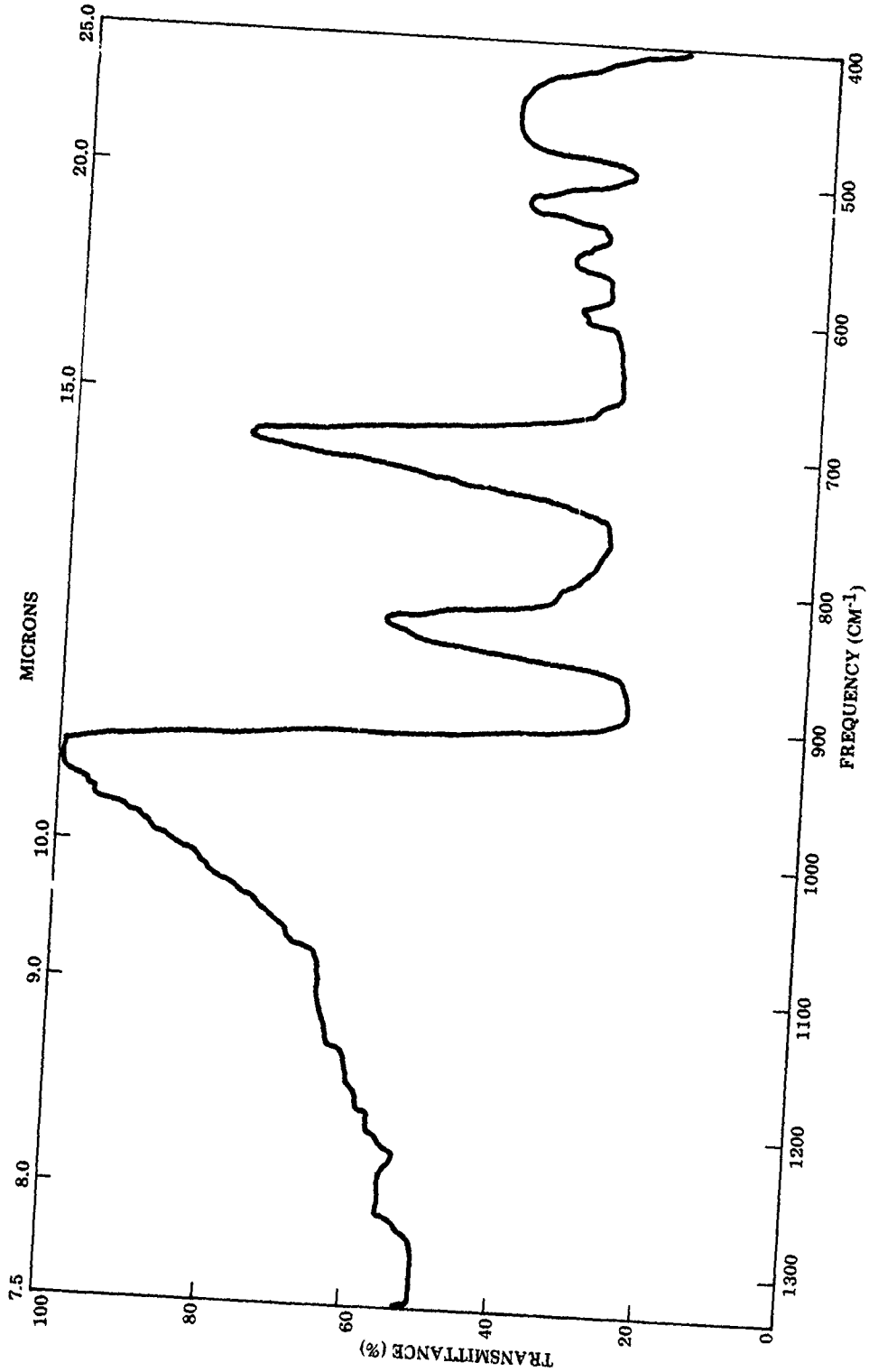


Figure 1. Infrared Spectrum of the Mixture of $\text{ClF}_6^+ \text{PtF}_6^-$ and $\text{ClF}_4^+ \text{PtF}_6^-$

CONFIDENTIAL

CONFIDENTIAL

TABLE I. (C) X-RAY POWDER DATA FOR $\text{ClF}_6^+ \text{PtF}_6^-$ *

$d_{(\text{obsd})}$	$d_{(\text{calcd})}$	hkl	Intensity
5.717	5.74	110	Strong
4.036	4.06	200	Very Strong
3.328	3.32	211	Medium
2.576	2.569	310	Light
2.334	2.345	222	Medium
1.999	2.030	400	Light
1.923	1.915	411	Very Light
1.774	1.772	421	Very Light
1.727	1.732	332	Very Light
1.530	1.535	520, 432	Very Light

* Tentatively identified as having a cubic symmetry.

CONFIDENTIAL

(U) BIBLIOGRAPHY

1. B. Weinstock, J.G. Maln, and E.E. Weaver, J. Am. Chem. Soc., 83, 4310 (1961).
2. N. Bartlett and D.H. Lohmann, J. Chem. Soc., 5253 (1962).
3. N. Bartlett and D.H. Lohmann, J. Chem. Soc., 619 (1964).
4. N. Bartlett and S.P. Beaton, Chem. Communs., 167 (1966).
5. F.P. Gortsema and R.H. Toeniskoetter, Inorg. Chem., 5, 1217 (1966).
6. F.P. Gortsema and R.H. Toeniskoetter, Inorg. Chem., 5, 1925 (1966).
7. D. Pilipovich, et al, Inorg. Chem., 6, 1918 (1967).
8. F.Q. Roberto and G. Mamantov, Inorg. Chem. Acta., 2:3 317 (1968).
9. K.O. Christe and D. Pilipovich, Inorg. Chem., 8, 391 (1969).
10. E.W. Lawless, et al; "Research on Advanced Oxidizers Having Kinetically Derived Stability"; AFRPL-TR-68-218, AD 394848; Midwest Research Institute, Kansas City, Missouri; November 1968; Confidential Report.
11. W.E. Tolberg, et al; "Synthesis of Energetic Oxidizers"; AFRPL-TR-69-76, AD 501546; Stanford Research Institute, Menlo Park, California; April 1969; Confidential Report.
12. D. Pilipovich, et al; "Inorganic Halogen Oxidizers"; Annual Report No. R-7881, AD 502016; Rocketdyne, Canoga Park, California; May 1969; Confidential Report.
13. B. Weinstock, H.H. Claassen and J.G. Malm, J. Chem. Phys., 32, 181 (1960).
14. F.E. Beamish, "The Analytical Chemistry of the Noble Metals", Pergamon Press, Oxford, P. 307 (1966).
15. M.S. Front and J.W. Ross, Jr. Science, 154, 1553 (1966).
16. G.M. Begun, W.H. Fletcher, and D.F. Smith, J. Chem. Phys., 42, 2236 (1965).

CONFIDENTIAL

(This page is unclassified)

UNCLASSIFIED

17. F.Q. Roberto. To be published
18. K.O. Christe and W. Sawodny, Inorg. Chem., 6, 1783 (1967).

DISTRIBUTION

<p>Bureau of Mines Attn: ERC Library 4800 Forbes Avenue Pittsburgh PA 15213</p>	1	<p>NASA Langley Research Center Attn: Librarian Langley Station Hampton VA 23565</p>	3
<p>Central Intelligence Agency Attn: CRS/ADD-Standard Dist Washington DC 20505</p>	1	<p>NASA Manned Spacecraft Center Attn: Library/Code BM6 Houston TX 77058</p>	1
<p>Chemical Propulsion Info Agency Applied Physics Lab-JHU 8621 Georgia Avenue Silver Spring MD 20910</p>	2	<p>NASA Kennedy Space Center Attn: Library-ATS-132C Kennedy Space Center FL 32899</p>	1
<p>Defense Documentation Center Attn: TSR Cameron Station, Bldg. 5 Alexandria VA 22314</p>	20	<p>NASA Attn: Code RPS, R. W. Ziem Washington DC 20546</p>	1
<p>Defense Rsch. & Engrg Pentagon, 3D1065 Attn: Propulsion Technology Washington DC 20301</p>	1	<p>Air Force Systems Command Director of Laboratories Attn: SCTSP Andrews AFB Wash DC 02331</p>	1
<p>Institute for Defense Analyses Attn: Classified Library 400 Army-Navy Drive Arlington VA 22202</p>	1	<p>AF Office of Scientific Research Attn: SREP 1400 Wilson Blvd Arlington VA 22209</p>	1
<p>NASA Lewis Research Center Attn: Librarian 21000 Brookpark Road Cleveland, OH 44135</p>	1	<p>Air Force Rocket Propulsion Lab Attn: RPCS Edwards CA 93523</p>	8
<p>NASA Scientific & Tech Info Facility Attn: SAF/DL, ACQ Div P. O. Box 33 College Park MD 20740</p>	1	<p>Air Force Rocket Propulsion Lab Attn: RPR Edwards CA 93523</p>	1
<p>NASA Goddard Space Flight Center Attn: Library, Code 252 Greenbelt MD 20771</p>	1	<p>Air Force Rocket Propulsion Lab Attn: RPM Edwards CA 93523</p>	1

AFPRL Attn: Technical Library Edwards CA 93523	1	Naval Air Systems Cmd Attn: AIR-330 Washington DC 20360	2
Foreign Technology Div Attn: TDBTL Wright-Patterson AFB OH 45433	1	Naval Ordnance Sys Cmd Attn: ORD-0331 Washington DC 20360	2
Army Ballistic Res. Labs Attn: AMXBR-1 Aberdeen Proving Grou 1 MD 21005	1	Naval Missile Center Attn: Code 5632.2, Tech Library Point Mugu CA 93041	1
Army Missile Command Redstone Scientific Info Center Attn: Chief, Document Section Redstone Arsenal AL 35809	4	Naval Ordnance Laboratory Attn: Library White Oak Silver Spring MD 20910	2
Army Research Office Attn: CRD-AA-IP Box CM, Duke Station Durham, NC 27706	1	Naval Weapons Center Attn: Code 753-Tech Library China Lake CA 93555	2
Frankford Arsenal Attn: C2500-Library-B51-2 (for Propellant & Expl. Section) Philadelphia PA 19137	1	Naval Postgraduate School Attn: Library, Tech Rpts Section-2124 Monerey CA 93940	1
Picatinny Arsenal Scientific & Tech Info. Br. Attn: SMUPA-VA6, Librarian Dover NJ 07801	2	Naval Ordnance Station Attn: Technical Library Indian Head MD 20640	1
White Sands Missile Range Attn: Technical Library White Sands MR NM 88002	1	Naval Research Branch Office Attn: Librarian 1030 East Green Street Pasadena CA 91101	1
Naval Air Systems Cmd. Attn: AIR-6042, Tech Library Washington DC 20360	1	Naval Research Attn: Code 429, Power Branch Washington DC 20360	1
Naval Air Systems Cmd AIR-53671 Washington DC 20360	2	Naval Ordnance Sys Cmd Attn: ORD-9132 Tech Library Washington DC 20360	2
Naval Air Systems Cmd. Attn: AIR-5366 Washington DC 20360	1	Naval Special Projects Attn: Technical Library Washington DC 20360	1

Naval Underwater Weapons Res Eng Sta Attn: Tech Library (CS12) Newport RI 02840	1	Dow Chemical Co Scientific Projects Laboratory Attn: R.S. Karpiuk, Bldg 1710 Midland MI 48641	1
Aerojet-General Corp Attn: Tech Library P.O. Box 296 Azusa CA 91702	1	DuPont Co. Eastern Division Attr: Report Clerk, A.R. Steward Gibbstown NJ 08027	1
Aerojet-General Corp Attn: Library 11711 South Woodruff Ave Downey CA 90241	1	Esso Research & Engineering Co Govt. Rsch Lab. Attn: Defense Security Officer P.O. Box 8 Linden NJ 07036	1
Aerojet-General Corp Attn: Tech Library-2432-2015A P.O. Box 15847 Sacramento CA 95813	3	Garrett Corp Airesearch Mfg. Div Attn: Tech Library 2525 W. 190th St. Torrance CA 90509	1
Aerospace Corp Attn: Tech Info Ctr. Doc. Group P.O. Box 95085 Los Angeles CA 90045	2	General Dynamics Corp Pomona Division Attn: Div. Library, Mail Zone 6-20 P.O. Box 2507 Pomona CA 91766	1
Aerotherm Corp. Attn: Library 485 Clyde Ave. Mountain View CA 94040	1	General Dynamics/Convair Library & Info Services P.O. Box 12009 San Diego CA 92112	1
Allied Chemical Corp Attn: Security Officer P.O. Box 70 Morristown NJ 07960	1	General Electric Co Attn: Acquisitions Bldg 4, Room 109 Daytona Beach FL 32015	1
ARO, Inc Attn: Technical Documents Library Arnold AF Station TN 37389	1	Hercules, Inc Allegany Ballistics Lab Attn: Tech Library P.O. Box 210 Cumberland MD 21502	1
Bell Aerosystems Co Attn: Technical Library P.O. Box 1 Buffalo NY 14240	1	Hercules, Inc Research Center Attn: Tech Info Center Wilmington DE	1
Boeing Co. Attn: Aerospace Library-8K-38 P.O. Box 3999 Seattle WA 98124	1		

California Inst of Technology Jet Propulsion Laboratory Attn: Library, TDS 4800 Oak Grove Drive Pasadena CA 91103	1	North American Rockwell Space & Information Systems Div Attn: Tech Info Ctr -096-722 12214 Lakewood Blvd Downey CA 90241	1
IIT Research Institute Attn: Document Library 10 West 35th Street Chicago IL 60616	1	Philco-Ford Corp Aeronutronic Div Attn: Tech Info Svcs-Acquisitions Ford Road Newport Beach CA 92663	1
Lockheed Missiles & Space Co. Attn: Tech Info Ctr. 50-14 3251 Hanover St Palto Alto CA 94304	1	Princeton University Forrestal Campus Library Attn: Librarian P.O. Box 710 Princeton NJ 08540	1
Lockheed Propulsion Co Attn: Library P.O. Box 111 Redlands CA 92373	2	Rocket Research Corp Attn: Technical Library York Center Willow Road at NE 116th St. Redmond WA 98052	1
Marquardt Corp Attn: Library P.O. Box 2013, So. Annex Van Nuys CA 91409	1	Rohm & Hass Co. Redstone Research Labs Attn: Tech Library Huntsville AL 35807	1
Martin Marietta Corp Attn: Library - Mail No. 6366 Denver Division P.O. Box 179 Denver CO 80201	1	Stanford Research Institute Document Center For Propulsion Sciences 333 Ravenswood Avenue Menlo Park CA 94025	1
McDonnell Douglas Corp. Douglas Missile & Space Systems Div Attn: Library A2-260 3000 Ocean Park Blvd Santa Monica CA 90406	1	Susquehanna Corp. Atlantic Research Group Attn: Library Shirley Highway at Edsall Rd Alexandria VA 22314	1
North American Rockwell Rocketdyne Division Attn: Library Dept 086-306 6633 Canoga Avenue Canoga Park CA 91304	3	Thiokol Chemical Corp Wasatch Division Attn: Technical Library Brigham City UT 84302	2

Thiokol Chemical Corp Elkton Division Attn: Tech Info Center Elkton MD 21921	1	Hq USAF Attn: AFRDDG, A. Eaffy Washington DC 20330	1
Thiokol Chemical Corp Huntsville Division Attn: Technical Library Huntsville AL 35807	1	AF Rocket Propulsion Lab Attn: RPCE Edwards CA 93523	1
TRW Systems, Inc. Attn: Technical Info Center One Space Park Redondo Beach CA 90278	2	Ethyl Corporation Attn: Program Mgr P.O. Box 53091 Baton Rouge LA 70805	1
United Aircraft Corp Attn: Acquisitions Librarian 400 Main Street East Hartford CT 06108	1	Hercules, Inc. Bacchus Works Attn: Library 100-H-2 P.O. Box 98 Magna UT 84044	1
United Aircraft Corp Pratt & Whitney Aircraft Div Attn: Head Librarian P.O. Box 2691 West Palm Beach FL 33402	1	Martin-Marietta Corp Res Inst for Adv Studies Attn: Security Officer 1450 South Rolling Road Baltimore MD 21227	1
United Technology Center Attn: Technical Library P.O. Box 358 Sunnyvale CA 94088	1	Midwest Research Institute Attn: Library-Documents 425 Volker Blvd Kansas City MO 64110	1
University of Denver Denver Research Institute Attn: Security Officer P.O. Box 10127 Denver CO 80210	1	Northrop Carolina, Inc. Attn: Library P.O. Box 3049 Ashville NC 28802	1
SAMSO (SMMAP) Attn: Mercury AF Unit Post Office Los Angeles CA 90045	2	Olin Mathieson Chemical Corp Main Control Room Attn: Asst Librarian 275 Winchester Avenue New Haven CT 06504	1
Los Alamos Scientific Laboratory Attn: Report Library P.O. Box 1683 Los Alamos NM 87544	1	Shell Oil Co. Shell Development Co. Div. Attn: Technical Files 1400 53rd Street Emeryville CA 94608	1

Confidential

Security Classification

DOCUMENT CONTROL DATA - R & D		
<i>(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)</i>		
1. ORIGINATING ACTIVITY (Corporate author) Air Force Rocket Propulsion Laboratory Edwards, California 93523		2a. REPORT SECURITY CLASSIFICATION Confidential
		2b. GROUP 4
3. REPORT TITLE The Synthesis of New Ionic Interhalogen Oxidizers (U)		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Phase Report July 1968 - July 1969		
5. AUTHOR(S) (First name, middle initial, last name) Roberto, Francisco Q.		
6. REPORT DATE October 1969	7a. TOTAL NO OF PAGES	7b. NO OF REFS 18
8a. CONTRACT OR GRANT NO	9a. ORIGINATOR'S REPORT NUMBER(S) AFRPL-TR-69-219	
b. PROJECT NO 3148		
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d.		
10. DISTRIBUTION STATEMENT In addition to security requirements which must be met, this document is subject to special export controls and each transmittal to foreign governments or foreign nationals may be made only with prior approval of AFRPL (REPORT-STINFO), Edwards, California 93523.		
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY Air Force Rocket Propulsion Laboratory Air Force Systems Command, USAF Edwards, California
13. ABSTRACT (C) The synthesis of hexafluorochloronium (VII) hexafluoroplatinate (V), $\text{ClF}_6^+\text{PtF}_6^-$, from the reaction of chlorine pentafluoride and platinum hexafluoride is described as an oxidation-reduction reaction. This has been confirmed by elemental analyses, infrared and Raman spectroscopy, X-ray powder diffraction and displacement reaction with trifluorochlorine oxide. This is the first example of a perfluorinated heptavalent chlorine cation. The compound, $\text{ClF}_6^+\text{PtF}_6^-$, based on preliminary X-ray powder pattern, has been indexed as having a cubic structure.		

DD FORM 1473
1 NOV 65

21

Confidential

Security Classification

Confidential

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Heptavalent chlorine Hexafluorochloronium Interhalogen						

Confidential

Security Classification