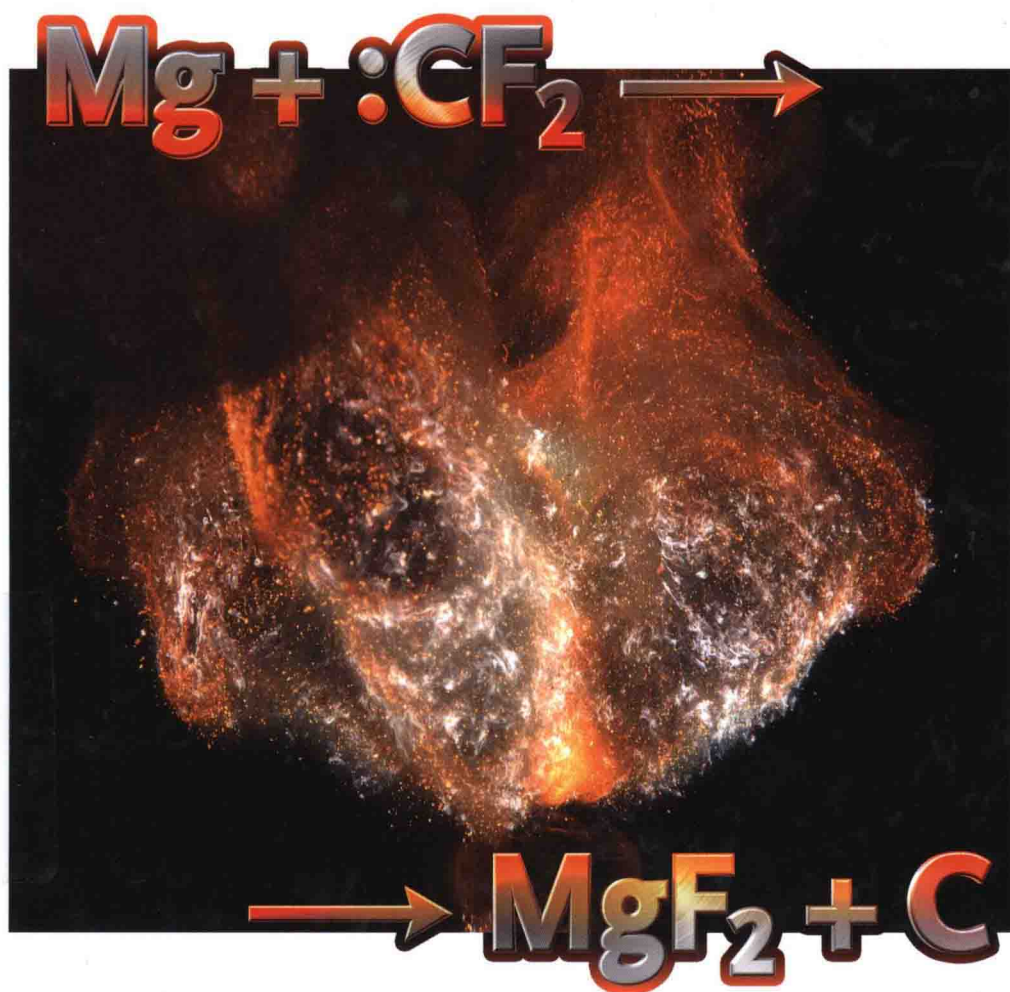
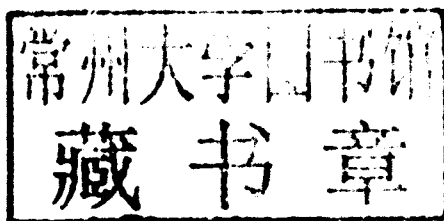


Metal-Fluorocarbon Based Energetic Materials



Ernst-Christian Koch

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Cover

The cover picture depicts the combustion flame of Magnesium/Teflon™/Hycar™ strand (photographed by Andrzej Koleczko, Fraunhofer ICT, Germany) superimposed on the assumed main combustion step between difluorocarbene and magnesium.

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Dedicated to my family

Foreword

We have known Dr Ernst-Christian Koch since meeting him during one of the International Pyrotechnics Seminar back in the 1990s. Even back then, we knew that he was more than just a research scientist interested in pyrolants and energetics. Dr Koch demonstrated a passion for pyrolants beyond that of a hobbyist or an employee. His enthusiasm is clearly demonstrated by the impressive number of his patents and publications. Therefore, it comes as no surprise that Dr Koch has channelled his drive for the dissemination of knowledge about pyrolants, and more specifically magnesium-Teflon-Viton (MTV) compositions into a clearly written book. Often, we will receive an email from Dr Koch that directs us to information about a new patent or publication about MTV. His ability to take a small amount of information and extrapolate beyond it is just one facet of his talent as a scientist. It is a pleasure to finally read a book that encompasses some (obviously, not all) of his knowledge in the field of pyrolants.

This book is unique in that its scope is limited to data about the MTV reaction, application of the reactions related to MTV, and metal–halogen reactions that might be substituted for the MTV reaction. The book provides the reader a single source for research results and data on all compositions related to MTV and the application thereof. The breadth of references, figures and tables demonstrate the vast and careful research Dr Koch undertook.

This book fills a void in the collection of pyrotechnic literature because it deals exclusively with research related to MTV-like compositions. Chapter 9 includes pictures that enable the reader to actually envision the combustion reaction of the different metal/fluoride reactions. Chapter 10 and 10.5 Operational Effects chapters are limited, only because of the availability and security constraints beyond the author's control. Chapters delving into previously unconsidered regions and Chapters 11 and 13 are of notable interest in the context of cyberwar and intellectual property disputes. Chapters 18 and 19 are a great compilation of the past and current practices. The history of the incidents involved with MTV manufacturing and the way processing has evolved to help mitigate explosive incidents is presented in a straightforward manner. Chapter 15 exemplifies Dr Koch's ability to look ahead. His citations in this chapter are abundant for a very limited field of research. Once again, the author illustrates his ability to take new information/ideas and to compile them in a useful and informative way.

No other known book documents MTV-like compositions in this depth. This book can be considered to be a textbook of everything associated with the MTV composition and, because of the extraordinary amount of documentation of data about MTV-like compositions, it will make an excellent reference book that all researchers of pyrolants and energetics must have.

*Dr Bernard Doua and Dr Sara Pliskin
Naval Surface Warfare Center,
Crane, Indiana, USA*

Preface

Metal/Fluorocarbon pyrolants, similar to black powder, are very versatile energetic materials with a great many number of applications. Over the last 50 years metal/fluorocarbon-based energetic materials have developed from secret laboratory curiosities into well-acknowledged standard payload materials for high-performance ordnance such as countermeasure flares and both strategical and tactical missile igniters. However, the long-lasting obligation to maintain secrecy over many of these compositions in most countries affected their further development and impeded personnel involved in becoming acquainted with the particular safety and sensitivity characteristics of these materials.

When I first dealt with Magnesium/TeflonTM/VitonTM (MTV) in the mid 1990s I became fascinated by these materials. However, trying to learn more about them was difficult because of the above mentioned classification issues. Thus my research aimed at exploring some of the fundamentals of MTV to have good basis to start further development on. Fortunately, in the meantime the Freedom of Information Act both in the United States and United Kingdom brought significant relief to this and has enabled access to formerly classified files. Still the information is not readily retrievable as the actual content of these files is not well documented. Thus, in order to establish a reference base for MTV, I have gathered documents from the public domain over the last 15 years. The present book now is the result of an attempt to present the most relevant information in a reasonable manner.

Even though carefully compiled, I preemptively apologize for any kind of technical errors and omissions which I am afraid cannot be completely avoided. However, I would be glad to receive your critical comments in order to improve future editions of this book.

I hope you enjoy reading the book as much as I enjoyed writing it.

Brussels and Kaiserslautern, October 2011

Ernst-Christian Koch

Acknowledgment

A book like this is never the achievement of a single individual. Thus I wish to express my sincere appreciation for the support I received during my research on metal fluorocarbon based energetic materials and while writing this monograph.

The late Dr. rer. nat. Peter Kalisch (†2010), retired technology and scientific director of the Diehl Stiftung/Nuremberg I gratefully acknowledge for his enduring, constructive and friendly support, and facilitating financial support for research on both combustion synthesis and obscurant properties of magnesium/graphite fluoride pyrolants.

I wish to thank the following individuals (in no certain order) for their advice both oral and written and/or their experimental support on this fascinating topic which has helped me in writing this book.

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Finally I wish to thank Dr. Bernard E. Douda for inviting me to become actively involved with the International Pyrotechnics Society. I thank him for his help and the friendly support he provided in response to the many questions I addressed to him over the years. I greatly appreciate his reviewing of parts of this book and his efforts to write a preface together with Dr. Sara Pliskin. It is his report on the “Genesis of IRCM” that has definitely triggered me to write this book.

Thank you Bernie!

Brussels and Kaiserslautern, October 2011

Ernst-Christian Koch

Contents

Foreword XIII

Preface XV

Acknowledgment XVII

1 Introduction to Pyrolants 1
References 3

2 History 6
2.1 Organometallic Beginning 6
2.2 Explosive & Obscurant Properties 8
2.3 Rise of Fluorocarbons 10
2.4 Rockets Fired Against Aircraft 13
2.5 Metal/Fluorocarbon Pyrolants 15
References 17
Further Reading 19

3 Properties of Fluorocarbons 20
3.1 Polytetrafluoroethylene (PTFE) 20
3.2 Polychlorotrifluoroethylene (PCTFE) 22
3.3 Polyvinylidene Fluoride (PVDF) 24
3.4 Polycarbon Monofluoride (PMF) 25
3.5 Vinylidene Fluoride–Hexafluoropropene Copolymer 27
3.5.1 LFC-1 28
3.6 Vinylidene Fluoride–Chlorotrifluoroethylene Copolymer 28
3.7 Copolymer of TFE and VDF 30
3.8 Terpolymers of TFE, HFP and VDF 31
3.9 Summary of chemical and physical properties of common fluoropolymers 33
References 33

4 Thermochemical and Physical Properties of Metals and their Fluorides 36
References 41

5	Reactivity and Thermochemistry of Selected Metal/Fluorocarbon Systems	42
5.1	Lithium	42
5.2	Magnesium	45
5.3	Titanium	47
5.4	Zirconium	52
5.5	Hafnium	53
5.6	Niob	53
5.7	Tantalum	54
5.8	Zinc	55
5.9	Cadmium	56
5.10	Boron	57
5.11	Aluminium	59
5.12	Silicon	63
5.13	Calcium Silicide	64
5.14	Tin	65
	References	66
6	Ignition and Combustion Mechanism of MTV	68
6.1	Ignition and Pre-Ignition of Metal/Fluorocarbon Pyrolants	68
6.2	Magnesium–Grignard Hypothesis	68
	References	77
7	Ignition of MTV	80
	References	85
8	Combustion	87
8.1	Magnesium/Teflon/Viton	87
8.1.1	Pressure Effects on the Burn Rate	87
8.1.2	Particle Size Distribution and Surface Area Effects on the Burn Rate	88
8.2	Porosity	95
8.3	Burn Rate Description	96
8.4	Combustion of Metal–Fluorocarbon Pyrolants with Fuels Other than Magnesium	97
8.4.1	Magnesium Hydride	97
8.4.2	Alkali and Alkaline Earth Metal	98
8.4.2.1	Lithium	98
8.4.2.2	Magnesium–Aluminium Alloy	99
8.4.3	Titan	99
8.4.4	Zirconium	102
8.4.5	Zinc	103
8.4.6	Boron	104
8.4.7	Magnesium Boride, MgB_2	105
8.4.8	Aluminium	105

- 8.4.9 Silicon 108
- 8.4.10 Silicides 110
 - 8.4.10.1 Dimagnesium Silicide, Mg_2Si 110
 - 8.4.10.2 Calcium Disilicide 111
 - 8.4.10.3 Zirconium Disilicide 113
- 8.4.11 Tungsten–Zirconium Alloy 113
- 8.5 Underwater Combustion 114
- References 115

9 Spectroscopy 119

- 9.1 Introduction 119
- 9.2 UV–VIS Spectra 120
 - 9.2.1 Polytetrafluoroethylene Combustion 121
 - 9.2.2 Magnesium/Fluorocarbon Pyrolants 122
 - 9.2.3 MgH_2 , MgB_2 , Mg_3N_2 , $\text{Mg}_2\text{Si}/\text{Mg}_3\text{Al}_2$ /Fluorocarbon Based pyrolants 128
 - 9.2.4 Silicon/PTFE Based Pyrolants 133
 - 9.2.5 Boron/PTFE/Viton Based Pyrolants 134
- 9.3 MWIR Spectra 135
 - 9.3.1 Polytetrafluoroethylene Combustion 136
 - 9.3.2 Magnesium/Fluorocarbon Combustion 136
 - 9.3.3 MgH_2 , MgB_2 , Mg_3N_2 , Mg_2Si /Fluorocarbon Based Pyrolants 139
 - 9.3.4 Si/Fluorocarbon Based Pyrolants 140
 - 9.3.5 Boron/PTFE/Viton Based Pyrolants 141
- 9.4 Temperature Determination 141
 - 9.4.1 Condensed-Phase Temperature 142
 - 9.4.2 Gas-Phase Temperature 144
- References 148

10 Infrared Emitters 151

- 10.1 Decoy Flares 151
- 10.2 Nonexpendable Flares 153
 - 10.2.1 Target Augmentation 153
 - 10.2.2 Missile Tracking Flares 156
- 10.3 Metal–Fluorocarbon Flare Combustion Flames as Sources of Radiation 158
 - 10.3.1 Flame Structure and Morphology 160
 - 10.3.2 Radiation of MTV 162
- 10.4 Infrared Compositions 165
 - 10.4.1 Inherent Effects 166
 - 10.4.1.1 Influence of Stoichiometry 166
 - 10.4.2 Spectral Flare Compositions 180
 - 10.4.3 Particle Size Issues 181
 - 10.4.4 Geometrical Aspects 181
- 10.5 Operational Effects 184

10.5.1	Altitude Effects	184
10.5.2	Windspeed Effects	186
10.6	Outlook	191
	References	193
11	Obscurants	197
11.1	Introduction	197
11.2	Metal–Fluorocarbon Reactions in Aerosol Generation	199
11.2.1	Metal–Fluorocarbon Reactions as an Exclusive Aerosol Source	200
11.2.2	Metal–Fluorocarbon Reactions to Trigger Aerosol Release	201
11.2.2.1	Metal–Fluorocarbon Reactions to Trigger Soot Formation	201
11.2.2.2	Metal–Fluorocarbon Reactions to Trigger Phosphorus Vaporisation	204
	References	208
12	Igniters	210
	References	214
13	Incendiaries, Agent Defeat, Reactive Fragments and Detonation Phenomena	216
13.1	Incendiaries	216
13.2	Curable Fluorocarbon Resin–Based Compositions	217
13.3	Document Destruction	218
13.4	Agent Defeat	221
13.5	Reactive Fragments	223
13.6	Shockwave Loading of Metal–Fluorocarbons and Detonation-Like Phenomena	229
	References	232
	Further Reading	234
14	Miscellaneous Applications	235
14.1	Submerged Applications	235
14.1.1	Underwater Explosives	235
14.1.2	Underwater Flares	235
14.1.3	Underwater Cutting Torch	236
14.2	Mine-Disposal Torch	238
14.3	Stored Chemical Energy	240
14.3.1	Heating Device	240
14.3.2	Stored Chemical Energy Propulsion	240
14.4	Tracers	240
14.5	Propellants	241
	References	244
15	Self-Propagating High-Temperature Synthesis	247
15.1	Introduction	247

15.2	Magnesium	249
15.3	Silicon and Silicides	252
	References	256
16	Vapour-Deposited Materials	258
	References	262
17	Ageing	264
	References	270
18	Manufacture	271
18.1	Introduction	271
18.2	Treatment of Metal Powder	271
18.3	Mixing	273
18.3.1	Shock Gel Process	273
18.3.1.1	Procedure A	273
18.3.1.2	Procedure B	275
18.3.2	Conventional Mixing	276
18.3.3	Experimental Super Shock Gel Process	276
18.3.4	Experimental Dry Mixing Technique	280
18.3.5	Experimental Cryo-N ₂ Process	282
18.3.6	Extrusion	282
18.3.6.1	Twin Screw Extrusion	282
18.4	Pressing	286
18.5	Cutting	289
18.6	Priming	289
18.7	Miscellaneous	289
18.8	Accidents and Process Safety	290
18.8.1	Mixing	290
18.8.2	Pressing	293
18.8.3	Process Analysis	294
18.8.4	Personal Protection Equipment (PPE)	294
	References	296
19	Sensitivity	299
19.1	Introduction	299
19.2	Impact Sensitivity	300
19.2.1	MTV	300
19.2.2	Titanium/PTFE/Viton and Zirconium/PTFE/Viton	300
19.2.3	Metal-Fluorocarbon Solvents	301
19.2.4	Viton as Binder in Mg/NaNO ₃	301
19.3	Friction and Shear Sensitivity	301
19.3.1	Metal/Fluorocarbon	303
19.4	Thermal Sensitivity	304
19.4.1	MTV	304

19.5	ESD Sensitivity	305
19.6	Insensitive Munitions Testing	310
19.6.1	Introduction	310
19.6.2	Cookoff	314
19.6.3	Bullet Impact	316
19.6.4	Sympathetic Reaction	319
19.6.5	IM Signature Summary	320
19.7	Hazards Posed by Loose In-Process MTV Crumb and TNT Equivalent	321
	References	323
20	Toxic Combustion Products	326
20.1	MTV Flare Composition	326
20.2	Obscurant Formulations	330
20.3	Fluorine Compounds	331
20.3.1	Hydrogen Fluoride	331
20.3.2	Aluminium Fluoride	331
20.3.3	Magnesium Fluoride	332
	References	332
21	Outlook	334
	References	335
	Index	337