
CONTENTS

Contributors	xiii
Introduction	xvii
Part One Detonation Initiation	1
INITIATION OF DETONATION IN GASEOUS AND TWO-PHASE MIXTURES	3
A. A. Borisov	
Introduction	4
Direct Initiation of Detonation	5
Initiation by Weak Sources	19
Acknowledgments	21
References	24
DETONATION INITIATION IN GASEOUS AND HETEROGENEOUS SYSTEMS	25
A. A. Vasil'ev, S. A. Zhdan, and V. V. Mitrofanov	
Introduction	25
Calculated Results for Gas-Droplets Mixtures	26
Approximate Initiation Model for Heterogeneous Gas-Droplets Systems	28
Approximate Initiation Models for Gaseous Systems	30
Comparison of Calculated and Experimental Results	33
Concluding Remarks	36
References	36
INITIATION OF ADIABATIC EXPLOSION BY ACCELERATED CURVED SHOCKS: A THEORETICAL AND NUMERICAL STUDY	39
P. Vidal and B. Khasainov	
Nomenclature	40
Introduction	41
Method	42
Application	46

Discussion	49
Acknowledgments	49
References	50
AMR CALCULATION OF IGNITION AND DETONATION FORMATION IN REACTIVE GAS BY SHOCK WAVE FOCUSING 51	
M. Rose, U. Uphoff, and P. Roth	
Introduction	51
Modeling	52
Results and Discussion	55
Concluding Remarks	60
References	63
DEFLAGRATION TO DETONATION TRANSITION IN GASES AND ITS APPLICATION TO PULSED DETONATION DEVICES 65	
N. N. Smirnov, V. F. Nikitin, A. P. Boichenko, M. V. Tyurnikov, and V. V. Baskakov	
Introduction	65
Background	66
Experimental Investigations	69
Numerical Investigations of the DDT Process	76
Application of the DDT Phenomenon in Pulsed Detonation Generators	86
Concluding Remarks	90
Acknowledgments	91
References	91
 Part Two Detonation Wave Structure and Propagation 95	
THE STRUCTURE OF PROPAGATING DETONATIONS 97	
E. S. Oran	
Introduction and Background	97
The Multi-Dimensional Structure of a Detonation Cell	98
Unreacted Detonation Pockets	105
Complex and Irregular Cell Structures	107
Universality of Cellular Structure	109
Oblique Detonations	111
Layered Detonations and Transmission	113
Discussion	117
Acknowledgments	118
References	118

ON RECTANGULAR AND DIAGONAL THREE-DIMENSIONAL STRUCTURES OF DETONATION WAVES 121

M. Hanana, M. H. Lefebvre, and P. J. Van Tiggelen

Introduction	121
Experimental Set-Up	122
Experimental Data	123
Discussion	125
Concluding Remarks	129
Acknowledgments	129
References	129

THEORY OF MULTI-DIMENSIONAL DETONATION INSTABILITY 131

Forman A. Williams

Introduction	131
Failure of One-Step Activation-Energy Asymptotics	132
Multi-Dimensional Instability at Zero Activation Energy	134
Bifurcation	135
Reduced Chemistry	137
Concluding Remarks	139
Acknowledgments	139
References	140

FORMATION OF HIGH-SPEED GAS FLOW AT COMBUSTION IN THE REGIME OF MULTI-STEP DETONATION 141

D. I. Baklanov, L. G. Gvozdeva, and N. B. Scherbak

Introduction	141
Single-Pulse Mode	142
Repeated Mode	147
Concluding Remarks	151
References	152

SIMULATION OF DETONATION CELLS IN WIDE CHANNELS 153

M. Nikolic, D. N. Williams, and L. Bauwens

Introduction	153
Physical and Numerical Model	154
Results	155
Discussion	158
Concluding Remarks	160
References	161

NUMERICAL SIMULATION OF THE STRUCTURE OF TWO-DIMENSIONAL DETONATIONS IN H_2-O_2-Ar	163
A. V. Trotsyuk	
Introduction	163
Physical Model	166
Numerical Method	168
Results of Computations	169
Concluding Remarks	175
Acknowledgments	176
References	176
Part Three Detonation Mitigation and Control	179
THE WAYS OF EXPLOSION CONTROL	181
V. V. Mitrofanov	
Introduction	181
First Way of Detonation Control: Velocity and Temperature . .	182
First Way of Detonation Control: Increasing Detonation Velocity Above D_{CJ}	185
First Way of Detonation Control: Pressure and Energy	185
Second Way of Detonation Control: Use of Nonstationary Explosion Processes	186
Third Way of Detonation Control: External Forcing	188
Fourth Way of Detonation Control: Shaping of Channel or Chamber	190
Concluding Remarks	192
References	193
PROPAGATION, DECAY AND RE-IGNITION OF DETONATIONS IN TECHNICAL STRUCTURES	197
M. Fischer, E. Pantow, and T. Kratzel	
Introduction	197
Modeling of Shock-Induced Combustion	198
Experimental Setup	199
Results of Experiments and Modeling	200
Concluding Remarks	207
References	211

INVESTIGATION OF H_2 +AIR FAST FLAME PROPAGATION AND DDT IN A TUBE WITH MULTI-DIMENSIONAL ENDPLATES	213
B. E. Gel'fand, S. V. Khomik, S. P. Medvedev, A. N. Polenov, A. M. Bartenev, W. Breitung, and A. Vesper	
Introduction	213
Experimental Procedure, Experimental Setup and Interpretation	
Method	215
Main Experimental Results	217
Concluding Remarks	221
References	223
INITIATION OF DETONATION IN A SUPERSONIC FLOW BEHIND A SHOCK WAVE UNDER NON-EQUILIBRIUM EXCITATION OF VIBRATIONAL DEGREES OF FREEDOM OF MOLECULES	225
A. M. Starik and N. S. Titova	
Introduction	225
Formulation	226
Kinetic Scheme of Non-Equilibrium Processes Behind a Shock Front	230
Solution Method and Main Results	234
Concluding Remarks	239
Acknowledgments	240
References	240
CONTROL OF PREDETONATION EXPLOSION PROCESSES IN PROPELLANTS	241
A. A. Sulimov and B. S. Ermolaev	
Introduction	241
Limits of Convective Burning	242
Methodology of the Study of Stabilized Convective Burning	242
Experimental Facilities and Techniques, Measured Parameters	243
Mechanisms and Conditions of Existence of Quasisteady Convective Burning in Low-Porosity Energetic Materials	246
Control of Propagation of Quasisteady Convective Burning in Low-Porosity Energetic Materials	248
Theoretical Modeling of Quasisteady Convective Burning	251
Applications of the High-Speed Controlled Convective Burning of the Compacted Low-Porosity Propellants	251
Concluding Remarks	252
Acknowledgments	253
References	254

ON ONE REGIME OF LOW-VELOCITY DETONATION IN
POROUS MEDIA 255

A. A. Korzhavin, V. A. Bunev, V. S. Babkin, M. Lawes, and D. Bradley

Introduction 255

Experimental Data on the Propagation Velocities of Combustion
Waves in the Sonic Velocity Regime 256

Lewis Number Effects 260

The Mechanism of Flame Propagation in High and Sonic Velocity
Regimes 263

Discussion and Concluding Remarks 265

Acknowledgments 266

References 267

Part Four Applications of Detonation Phenomena 269

RAM ACCELERATORS IN THE DETONATIVE MODE 271

K. Kailasanath and C. Li

Introduction 271

Numerical Models 273

Computational Results and Discussion 274

Shape Tailoring for Successful Operation 275

Dynamics of Detonations in RAM Accelerators 278

Structure and Stability of Oblique Detonations 281

Concluding Remarks 281

Acknowledgments 283

References 283

SOME ESTIMATIONS OF A POSSIBILITY TO UTILIZE
SHOCK-INDUCED COMBUSTION IN PROPULSION SYSTEMS 285

L. Bezgin, A. Ganzhelo, O. Gouskov, V. Kopchenov, and Yu. Yarunov

Introduction 285

Computational Models and Codes 287

Flow Structure in a Duct of Fixed Length and the Convergence
Ratio at Variable Wall Angle 287

Preliminary Estimation of a Possibility to Utilize Shock-Induced
Combustion in a Hypersonic Propulsion System 293

Shock-Induced Combustion in RAM Accelerator 297

Concluding Remarks 298

References 298

USE OF ELECTRO-PHYSICAL PROPERTIES OF DETONATION PRODUCTS IN EXPLOSIVE FAST OPENING SWITCHES	301
V. K. Chernyshev, V. V. Vakhrushev, G. I. Volkov, and V. A. Ivanov	
Introduction	301
Statement of the Problem and Experimental Results	302
Concluding Remarks	310
References	310
Part Five Detonability of Advanced Fuels	311
APPLICATION OF FUEL BLENDS FOR CONTROLLING DETONABILITY IN PULSED DETONATION ENGINES	313
S. M. Frolov, V. Ya. Basevich, A. A. Belyaev, and M. G. Neuhaus	
Introduction	313
Operation Conditions of a Pulsed Detonation Engine	314
Oxidation Mechanisms for Heavy Hydrocarbons	319
Oxidation Mechanism for <i>n</i> -Heptane- <i>iso</i> -Octane Blends	320
Control of Detonability	323
Concluding Remarks	327
Acknowledgments	328
References	328
SUPPRESSION OF DETONATIONS BY EFFICIENT INHIBITORS	331
V. V. Azatyan, H.-Gg. Wagner, G. K. Vedeshkin, and R. G. Aivazyan	
Introduction	331
Experimental Results	333
Discussion and Concluding Remarks	335
Acknowledgments	336
References	336
STUDY OF DETONATION INITIATION IN UNCONFINED ALUMINUM DUST CLOUDS	337
W. Ingignoli, B. Veyssiere, and B. A. Khasainov	
Introduction	338
Experimental Setup	339
Experiments	340
Numerical Study	345
Discussion	348
Acknowledgments	349
References	349

STRUCTURE OF A DETONATION WAVE IN A CHANNEL
PARTIALLY FILLED WITH A RDX PARTICLE SUSPENSION . . . 351

S. A. Zhdan and E. S. Prokhorov

Introduction	351
Formulation	351
Initial and Boundary Conditions	353
Calculation Results	355
Concluding Remarks	360
Acknowledgments	362
References	362

Concluding Remarks

NEW FRONTIERS IN DETONATION RESEARCH 363

G. D. Roy