

Contents

Chapter 1 KINETICS	1
A comprehensive kinetic submechanism for OH* chemiluminescence in hydrogen combustion <i>A. S. Sharipov, A. V. Pelevkin, and B. I. Loukhovitski</i>	3
Theoretical and experimental determination of the rate constant for the nonadiabatic chemiluminescent reaction $\text{H} + \text{O} + \text{N}_2 = \text{OH}^* + \text{N}_2$ <i>B. I. Loukhovitski, A. S. Sharipov, I. V. Arsentiev, A. V. Pelevkin, A. V. Skilandz, Yu. S. Kisel, and P. N. Krivosheyev</i>	5
Quasi-classical trajectory calculation of vibrationally-resolved rate constants for the $\text{O}(^3P) + \text{H}_2(v)$ system <i>A. V. Pelevkin, I. V. Arsentiev, and I. N. Kadochnikov</i>	7
Laser photolysis of O_2 and kinetics of O atom reaction with CH_4 behind reflected shock waves <i>N. S. Bystrov, A. V. Emelianov, E. S. Kurbatova, A. V. Eremin, and P. I. Yatsenko</i>	11
Singlet potential energy surface of the interaction of $\text{C}_3\text{H}_2 + \text{O}_2$: A theoretical study <i>A. S. Semenikhin, A. S. Savchenkova, S. S. Matveev, and S. G. Matveev</i>	13
Application of the molecular beam method for determining the perpendicular translational temperature in a supersonic nonequilibrium jet <i>E. D. Dering, A. E. Zarvin, V. V. Kalyada, and K. A. Dubrovin</i>	16
Energy disposal into the vibrational degrees of freedom of bimolecular reaction products: Main regularities and simple model <i>A. S. Sharipov and B. I. Loukhovitski</i>	19
The development of the kinetic model of ignition and combustion of alternative aviation condensed fuel in mixtures with air <i>V. A. Savelieva, A. M. Savel'ev, I. N. Kadochnikov, and D. V. Novakovsky</i>	21
Complex surrogates of the commercial jet fuel for modeling the operation process in combustion chambers of low-emission gas turbine engine <i>A. M. Savel'ev, V. A. Savelieva, D. V. Novakovsky, and A. N. Tarasenko</i>	29
Development of a surrogate mixture of kerosene with alcohols, ketones, and aldehydes taking into account the properties of the fractions <i>I. A. Zubrilin, Yu. G. Kuraeva, V. D. Chigishchev, and K. D. Tsapenkov</i>	37

Chapter 2 PLASMA, LASERS, AND NANOSTRUCTURES	41
Theoretical simulation of plasma jets of surface discharge <i>V. V. Kuzenov and S. V. Ryzhkov</i>	43
To determining the law of piston motion based on the measured density profile behind the shock wave front <i>A. S. Skriabin, A. V. Pavlov, Yu. Yu. Protasov, V. D. Telekh, and T. S. Shchepanyuk</i>	47
Characteristics of cold plasma jets in the presence of a target <i>E. A. Shershunova, S. I. Moshkunov, K. S. Gochelashvili, and P. I. Kapustin</i>	52
Influence of magnetic field on the shaping of plasma formation in a pulsed plasma accelerator <i>V. E. Zavalova, A. A. Kozlov, A. V. Kozlov, V. P. Polistchook, Yu. V. Karpushin, and M. A. Shurupov</i>	57
Experimental investigation of the expansion dynamics of the laser plasma generated on the water–dielectric, water–metal, and air–metal interfaces <i>V. D. Kobtsev, D. N. Kozlov, S. A. Kostritsa, I. A. Novikov, S. N. Orlov, V. V. Smirnov, and S. A. Shibaev</i>	61
Simulation and optimization of the yield of metastable argon atoms in a nanosecond repetitively pulsed discharge in Ar–He mixture at atmospheric pressure <i>A. D. Dvornikov, M. V. Zagidullin, and P. A. Mikheyev</i>	63
Controlling the discharge parameters of the two-stage vacuum arc magnetoplasma dynamic thruster by the additional third stage <i>D. B. Zolotukhin, P. C. Price, and M. Keidar</i>	68
<i>In situ</i> studies of electron-ion-plasma synthesis of multilayer functional structures using synchrotron radiation <i>A. D. Teresov, V. V. Denisov, N. N. Koval, N. A. Ratakhin, and A. N. Shmakov</i>	73
Fabrication of thin-film dispersed-reinforced polymer materials based on nanoparticles synthesized in plasma discharge under the influence of ultrasonic cavitation <i>N. A. Bulychev and A. Yu. Burova</i>	77
Application of a glow discharge at atmospheric pressure for generating nanoparticles of fusible metal oxides <i>K. P. Savkin, D. A. Sorokin, D. V. Beloplotov, A. G. Nikolaev, M. V. Shandrikov, and A. A. Cherkasov</i>	81
On the size distributions of nanostructures in laser relief formation <i>P. S. Kuleshov, E. V. Barmina, and I. O. Bruslavsky</i>	87
On the possibility of creating an anti-icing nanorelief coating during laser nanostructuring <i>P. S. Kuleshov</i>	91

On the possibility of using molecular beam mass spectrometry to simulate the process of collisions of fast cluster particles with a background gas <i>E. D. Dering, K. A. Dubrovin, A. E. Zarvin, and V. V. Kalyada</i>	95
Pyrotechnic generation of nanoscale titanium dioxide to combat local air pollution <i>O. G. Glotov, N. S. Belousova, I. V. Sorokin, and G. S. Surodin</i>	98

Chapter 3 IGNITION AND COMBUSTION 101

Determination of the smoke point during the combustion of mixtures of petroleum hydrocarbons with alcohols, ketones, and aldehydes <i>K. D. Tsapenkov, Yu. G. Kuraeva, E. I. Sidorova, and I. A. Zubrilin</i>	103
Features of modeling the heating and evaporation of droplets of complex shape <i>D. V. Antonov and P. A. Strizhak</i>	106
Transport and critical properties of composite fuel components <i>D. V. Volosnikov, A. A. Gubin, I. I. Povolotskiy, and P. V. Skripov</i>	109
Numerical modeling of a microexplosion of heterogeneous droplets taking into account combustion <i>D. V. Antonov and P. A. Strizhak</i>	113
Computational and analytical estimation of the influence of local macrokinetic reactions on the evaporation of dispersed liquid droplets <i>K. Yu. Arefyev and M. A. Abramov</i>	116
Investigation of large turbulent structures in the front of a model fire of different intensity with application of noncontact diagnostics methods <i>D. P. Kasymov, E. L. Loboda, M. V. Agafontsev, A. V. Lutsenko, V. V. Reyno, Yu. A. Loboda, A. A. Staroseltseva, and P. S. Martynov</i> ...	118
Simulation of heating of the heat-flux-sensor sensitive element in a transient high-speed flow with a heat source <i>I. R. Vasnev and N. N. Fedorova</i>	121
Heat flux registration during self-ignition of combustible mixtures <i>M. A. Kotov, P. V. Kozlov, V. Yu. Levashov, G. Ya. Gerasimov, N. G. Solovyov, A. N. Shemyakin, M. Yu. Yakimov, V. N. Glebov, G. A. Dubrova, and A. M. Malyutin</i>	124
Combustion of hydrocarbon fuels and climate change <i>V. F. Martynyuk</i>	127
Numerical simulation of fire suppression in aircraft compartment by refrigerant <i>L. V. Gurov</i>	131
Specific features of determining the concentration of polycyclic aromatic hydrocarbons in hydrocarbon fuel emissions <i>A. S. Savchenkova, A. A. Dudukin, S. V. Kurbatova, I. V. Chechet, and S. G. Matveev</i>	133
Patterns of physical and chemical processes during ignition of gel fuel particles <i>K. K. Paushkina, D. O. Glushkov, and A. O. Pleshko</i>	135

Movement and aerodynamic drag coefficient of titanium and aluminum particles during combustion in air <i>N. S. Belousova and O. G. Glotov</i>	140
On optimization of hydrogen production during combustion of aluminum nanopowder in steam <i>V. B. Storozhev and A. N. Yermakov</i>	143
Search for effective metallic fuels and methods of their activation <i>O. G. Glotov</i>	146
On the promotion mechanism of hydrocarbon combustion with aluminum nanoparticles <i>A. M. Savel'ev, D. A. Yagodnikov, V. V. Bernikov, and A. K. Shostov</i> ...	149
High-energy materials: Composition and combustion <i>V. A. Babuk, D. I. Kuklin, and S. Yu. Naryzhny</i>	155
The effect of cryolite on combustion parameters and agglomeration of composite propellants with aluminum <i>I. V. Sorokin, O. G. Glotov, and G. S. Surodin</i>	158
The effect of titanium on the combustion parameters of composite propellants <i>I. V. Sorokin, N. S. Belousova, O. G. Glotov, and G. S. Surodin</i>	160
On increasing the burning rate of solid rocket fuel <i>K. A. Moldosanov and V. M. Lelevkin</i>	163
Pyrrole-, pyrazole- and imidazole-containing tetracycles as potential components of solid fuels for gas generator engines <i>E. S. Amosova, V. M. Volokhov, V. V. Parakhin, and D. B. Lempert</i>	166
Computational estimation of the effect of the ignition delay period of alternative fuels on their combustion efficiency in cylindrical channels <i>L. S. Yanovskiy and K. Yu. Arefyev</i>	169
Experimental determination of ignition parameters of low-melting solid fuels <i>V. A. Usanov, G. V. Gembarzhevsky, S. A. Rashkovsky, and S. E. Yakush</i>	171
Influence of wood particle sizes in a coal-based solid fuel mixture on ignition and combustion characteristics <i>A. V. Zhuikov</i>	176
Combustion of fuel pellets based on biomass and waste <i>V. V. Dorokhov, K. Yu. Vershinina, G. S. Nyashina, and D. K. Shvedov</i>	179
Thermal decomposition of composite fuels based on coal and waste <i>V. V. Dorokhov, K. Yu. Vershinina, P. A. Strizhak, and D. K. Shvedov</i>	183
Calculation of the characteristics of the fire extinguishing aerosol generator and high-pressure spray for extinguishing oil and gas fountains <i>E. V. Kozlova, Yu. I. Kartashov, S. N. Kopylov, and O. I. Rogozhina</i>	188

Chapter 4 SHOCK WAVES AND DETONATION 193

Analytical model of shock wave structures with pulsed energy supply <i>M. V. Chernyshov and K. E. Savelova</i>	195
---	-----

Mathematical modeling of olefin production from natural gas by pulsed shock compression <i>S. M. Frolov, A. E. Kovalev, K. A. Avdeev, V. A. Smetanyuk, and K. D. Shulakov</i>	198
Reduced chemical reaction model and its application in combustion and detonation <i>Yuanxiang Sun</i>	201
On the velocity of the stationary nonideal detonation wave with one-step and two-step reaction law <i>R. E. Semenko</i>	203
Shock-to-detonation transition in a two-phase mixture of liquid triethylaluminum and superheated steam <i>S. M. Frolov, I. O. Shamshin, K. A. Byrdin, K. A. Avdeev, V. S. Aksenov, P. A. Storozhenko, and S. L. Guseinov</i>	209
Detonation propagation in stratified two-phase systems comprising gaseous oxidizer and liquid fuel film <i>V. S. Ivanov, S. M. Frolov, and I. V. Semenov</i>	212
Modeling of hybrid detonation in a nonuniform hydrogen–air gas suspension of aluminum particles <i>T. A. Khmel and A. A. Afanasenkov</i>	217
Analysis of the effect of aluminum particles distribution in the channel on the stability of hybrid detonation <i>S. A. Lavruk and T. A. Khmel</i>	220
Determination of chemical reaction zone parameters, von Neumann spike, and Chapman–Jouguet state in homogeneous high explosives <i>A. V. Fedorov, S. A. Finyushin, D. V. Nazarov, and L. K. Antonyuk</i>	222
Numerical simulation of experiments to estimate the critical diameter for explosives based on TATB using synchrotron radiation <i>A. L. Gamov, V. B. Titova, N. A. Volodina, M. O. Shirshova, S. A. Krayukhin, M. N. Kiryukhina, P. V. Urazov, I. A. Spirin, N. I. Ponomarev, E. R. Pruel, K. A. Ten, A. O. Kashkarov, A. A. Studennikov, A. S. Tumanik, and I. A. Rubtsov</i>	224
Computational and experimental research on propellant capabilities of HMX-based explosives using explosion-magnetic generator <i>V. B. Titova, N. A. Volodina, M. O. Shirshova, Z. D. Trunova, P. V. Duday, and A. A. Zimenkov</i>	227
Correlation between critical parameters of detonation defining the propagation limits of a detonation wave <i>A. V. Bessonova, D. A. Pronin, O. V. Shevlyagin, and Yu. V. Sheikov</i> ..	229
Numerical simulation of detonation propagation by models of Monte-Carlo kinetics in compositions based on conventional and nanostructured RDX <i>O. K. Linnik, O. O. Murugova, A. I. Pyatoikina, V. B. Titova, E. V. Khaldeev, and Yu. A. Shikhova</i>	231

The use of thermodynamic calculations for the construction of the equation of state for the detonation products of HMX-based high explosives <i>P. V. Zabusov, P. V. Dudai, T. A. Egorova, A. A. Zimenkov, A. R. Tangalycheva, V. B. Titova, and M. O. Shirshova</i>	234
---	-----

Chapter 5 ENGINES 237

The mechanism of the origin and development of the shear flow turbulence <i>I. V. Lebed</i>	239
Regimes of combustion of hydrogen microjets <i>V. V. Kozlov</i>	247
Simulation of combustion of high-speed transverse hydrogen jets in a rectangular duct using the IDDES approach <i>S. Bakhne and V. V. Vlasenko</i>	253
Estimation of the effect of oxidizer composition on the characteristics of hydrogen combustion in a model high-speed channel <i>K. Yu. Arefyev, O. V. Guskov, D. L. Mamyshev, and A. N. Prokhorov</i> ...	256
The influence of the physical and chemical characteristics of hydrogen on the design of combustion chambers of gas turbine engines <i>I. A. Zubrilin, D. V. Yakushkin, A. Yu. Kuznetsov, D. Vergnano, A. A. Tumanov, and N. S. Mironov</i>	260
Modeling of combustion stabilization in a turbulent flow using Lazurit software <i>L. A. Benderskiy, V. S. Ivanov, D. A. Lyubimov, and S. M. Frolov</i>	263
Problems of ignition of a supersonic jet of ethylene–air mixture by electric discharge <i>R. S. Troshkin, L. S. Volkov, Y. V. Miroshnikov, D. A. Tarasov, and A. A. Firsov</i>	267
A comprehensive analysis of flow structure in a supersonic channel with cavity <i>R. K. Seleznev</i>	271
Initiation of combustion in a pseudoshock by gasdynamic pulses when supplying fuel from the channel wall <i>V. N. Zudov and A. V. Tupikin</i>	273
Nonlinear dynamics of acoustic instability in a nonequilibrium chemically active gas: Numerical simulation and physical experiment <i>S. S. Khrapov, V. P. Radchenko, I. S. Makoveev, and G. S. Ivanchenko</i>	275
Modeling of pulsation combustion in a model gas turbine combustor <i>N. I. Gurakov, D. V. Idrisov, R. A. Ivanov, S. S. Matveev, and S. G. Matveev</i>	280
Computational and experimental study of the combustion of a methane–hydrogen mixture and hydrogen in a cluster-type burner device <i>S. S. Matveev, N. I. Gurakov, O. V. Kolomzarov, A. A. Litarova, and S. G. Matveev</i>	283

CONTENTS

Methodological aspects of calculating tangential self-oscillations in the gas flow in the combustion chamber of a gas turbine unit <i>M. V. Drobysh, A. N. Dubovitsky, A. B. Lebedev, D. S. Tarasov, N. I. Fokin, V. I. Furletov, and K. Ya. Yakubovsky</i>	286
Computational study of gas self-oscillations in combustion chambers of gas turbine installations <i>M. V. Drobysh, A. N. Dubovitsky, A. B. Lebedev, D. S. Tarasov, N. I. Fokin, V. I. Furletov, and K. Ya. Yakubovsky</i>	290
Method for determining the boundaries of flashback when using methane–hydrogen fuel in the combustion chambers of gas turbine engines and power plants <i>D. V. Idrisov, S. S. Matveev, S. G. Matveev, N. I. Gurakov, and Yu. V. Bobina</i>	293
The effect of incompleteness of the homogeneous fuel–air mixture formation in the combustion chamber on nitrogen oxide emissions <i>V. F. Goltsev, A. B. Lebedev, V. I. Furletov, and S. A. Schepin</i>	296
Influence of combustion of kerosene/water emulsion droplets on emission characteristics in the combustion chamber of an aviation gas turbine engine <i>M. Hernandez Morales, I. A. Zubrilin, K. A. Vilyamovsky, D. V. Antonov, and P. A. Strizhak</i>	300
Numerical simulation of cycloidal rotary engine <i>S. D. Zambalov and D. V. Kasaev</i>	304
Numerical simulation of a reactive mixture in a channel <i>V. A. Savelov, K. E. Savelova, and M. V. Chernyshov</i>	307
Prospects for the development of propulsion systems of civil aviation aircraft and the work of CIAM on creating scientific and technical reserve <i>A. V. Lukovnikov and A. I. Lanshin</i>	310
The main results of the World-Class Research Center “The Supersonic” in terms of the propulsion system of a supersonic passenger aircraft in 2022–2023 <i>A. I. Lanshin, D. V. Komratov, and A. D. Alendar’</i>	314
Investigation of three-dimensional effects influence on the flame front stabilization for subsonic premixed combustion <i>R. A. Balabanov</i>	321
Shock waves in an arcjet thruster <i>V. I. Gorbunkov</i>	324

Chapter 6 TECHNOLOGIES 327

Ways to increase the maximum registration base using the laser range finder method <i>S. A. Finyushin, A. V. Fedorov, E. A. Chudakov, D. A. Kalashnikov, I. S. Gnutov, and E. A. Razumkov</i>	329
--	-----

Results of the development of the experimental model of the lidar for measuring atmospheric greenhouse gases <i>S. A. Sadovnikov, S. V. Yakovlev, N. S. Kravtsova, D. A. Tuzhilkin, A. A. Nevzorov, M. P. Gerasimova, I. A. Vasilenko, and A. Ya. Sukhanov</i>	333
Generation of volumetric oxygen-containing plasma for technological processes of ion-plasma processing <i>V. V. Shugurov, N. N. Koval, and N. A. Prokopenko</i>	336
Electrothermal processes during high-voltage electric pulse consolidation of refractory powder materials <i>E. G. Grigoryev, E. L. Strizhakov, S. V. Nescoromniy, S. O. Ageev, A. N. Chumakov, I. S. Nikonchuk, and O. O. Kuznechik</i>	342
Deposition and study of multielement nanostructured metal films <i>E. A. Petrikova, Yu. F. Ivanov, N. A. Prokopenko, and V. V. Shugurov</i>	344
Metal and nitride coatings formed by vacuum arc method at evaporation of TiNbZrTaHf high-entropy alloy cathode <i>O. V. Krygina, Yu. F. Ivanov, N. A. Prokopenko, E. A. Petrikova, and V. V. Shugurov</i>	349
Gasification of oil sludge and petcoke using the method of detonation gun <i>S. M. Frolov, V. A. Smetanyuk, I. A. Sadykov, A. S. Silantiev, F. S. Frolov, V. Ya. Popkova, Y. K. Khasyak, A. G. Buyanovskaya, R. U. Takazova, T. V. Dudareva, V. G. Bekeshev, A. B. Vorobyov, A. V. Inozemtsev, and Ya. O. Inozemtsev</i>	355
Thermomechanical processing of mineral ores by pulsed detonation guns <i>S. M. Frolov, V. A. Smetanyuk, I. A. Sadykov, A. S. Silantiev, and F. S. Frolov</i>	358
Fine powder production from metal melts using pulsed detonation guns <i>S. M. Frolov, V. S. Ivanov, I. O. Shamshin, V. S. Aksenov, V. A. Smetanyuk, I. A. Sadykov, P. A. Gusev, and F. S. Frolov</i>	362