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Chemistry and Physics of Energetic Materials **Energetic Materials** **Green Energetic Materials** **Chemistry of Energetic Materials** **Energetic Materials** Advanced Energetic Materials **The Properties of Energetic Materials** *The Properties of Energetic Materials* High Energy Materials Energetic Materials at Extreme Conditions *Energetic Materials Energetic Materials Research, Applications, and New Technologies* **Innovative Energetic Materials: Properties, Combustion Performance and Application** Metal-Fluorocarbon Based Energetic Materials **Energetic Materials and Munitions** *Heat Flow Calorimetry on Energetic Materials Energetic Materials* Chemistry of High-Energy Materials **Recent Advances on Energetic Materials** *Emerging Energetic Materials: Synthesis, Physicochemical, and Detonation Properties* **Nano-Energetic Materials** **Energetic Polymers** *Molecular Modeling of the Sensitivities of Energetic Materials* Demystifying Explosives **Chemical Rocket Propulsion** *Energetic Materials Encyclopedia* **Mechanochemical Processes in Energetic Materials** **Decomposition, Combustion, and Detonation Chemistry of Energetic Materials** *Energetic Materials* Energetic Compounds **Co-crystals** *Energetic Nanomaterials* **Energy Materials Energetic**

Materials Energy Materials Synthesis and Characterization of Energetic Oxetane Derivatives and Nitrogen-rich Energetic Materials High Energy Density Materials Green Energy Materials Handbook *Propellants and Explosives* **Materials for Energy**

Demystifying Explosives: Concepts in High Energy Materials explains the basic concepts of and the science behind the entire spectrum of high energy materials (HEMs) and gives a broad perspective about all types of HEMs and their interrelationships. Demystifying Explosives covers topics ranging from explosives, deflagration, detonation, and pyrotechnics to safety and security aspects of HEMS, looking at their aspects, particularly their inter-relatedness with respect to properties and performance. The book explains concepts related to the molecular structure of HEMs, their properties, performance parameters, detonation and shock waves including explosives and propellants. The theory-based title also deals with important (safety and security) and interesting (constructive applications) aspects connected with HEMs and is of fundamental use to students in their introduction to these materials and applications. Explains the concept of high energy materials in simple language and down-to-earth examples Worked examples and problems are given wherever required Demystifies the concept of explosives Limited use of big and complex equations Questions and Suggested Reading are given at the end of each chapter Metal-Fluorocarbon Based Energetic Materials This exciting new book details all aspects of a major class of pyrolants and elucidates the progress that has been made in the field, covering both the chemistry and applications of these compounds. Written by a pre-eminent authority on the subject from the NATO

Munitions Safety Information Analysis Center (MSIAC), it begins with a historical overview of the development of these materials, followed by a thorough discussion of their ignition, combustion and radiative properties. The next section explores the multiple facets of their military and civilian applications, as well as industrial synthetic techniques. The critical importance of the associated hazards, namely sensitivity, stability and aging, are discussed in detail, and the book is rounded off by an examination of the future of this vital and expanding field. The result is a complete guide to the chemistry, manufacture, applications and required safety precautions of pyrolants for both the military and chemical industries. From the preface: "... This book fills a void in the collection of pyrotechnic literature... it will make an excellent reference book that all researchers of pyrolants and energetics must have..." Dr. Bernard E. Douda, Dr. Sara Pliskin, NAVSEA Crane, IN, USA Includes details of the fundamental phenomenological theories of solar cells, Li ion/ Li-air/Li-S batteries, fuel cells and their energy storage mechanisms. Discusses properties of various energy materials in addition to their device operation and evaluation. Includes details of the fundamental phenomenological theories of solar cells, Li ion/ Li-air/Li-S batteries, fuel cells and their energy storage mechanisms Discusses properties of various energy materials in addition to their device operation and evaluation This volume provides an overview of current research and recent advances in the area of energetic materials, focusing on decomposition, crystal and molecular properties. The contents and format reflect the fact that theory, experiment and computation are closely linked in this field. Since chemical decomposition is of fundamental importance in energetic performance, this volume begins with a survey of the decomposition processes of a variety of energetic

compounds. This is followed by detailed studies of certain compounds and specific mechanisms, such as nitro/aci-nitro tautomerism. Chapter 6 covers the transition from decomposition to crystal properties, with molecular dynamics being the primary analytical tool. The next several chapters deal with different aspects of the crystalline state, again moving from the general to particular. There is also a discussion of methods for computing gas, liquid and solid phase heats of formation. Finally, the last portion of this volume looks at the potential of high-nitrogen molecules as energetic systems; this has been of considerable interest in recent years. Overall, this volume illustrates the progress that has been made in the field of energetic materials and some of the areas of current activity. It also indicates the challenges involved in characterizing and understanding the properties and behaviour of these compounds. The work is a unique state-of-the-art treatment of the subject, written by pre-eminent researchers in the field. - Overall emphasis is on theory and computation, presented in the context of relevant experimental work - Presents a unique state-of-the-art treatment of the subject - Contributors are preeminent researchers in the field The book contains ten chapters. Chapter 1 deals with classification of propellants and explosives. Mechanism of thermal decomposition of ammonium perchlorate (AP) has been given in Chapter 2. Synthesis and characterisation of various types of nanomaterials such as oxides, ferrites, cobaltites, oxalates, mono, bi and tri metals of transition metals, and oxides of lanthanides have been discussed in Chapter-3. These have been found to be potential thermal decomposition and burning rate catalysts for AP and composite solid propellants. The preparative methods for various types of nanoenergetic compounds have been described in Chapter 4.

Thermolysis of various types of nitrate, perchlorate, and NTOate salts has been discussed in Chapters 5-7. Preparation and characterisation of transition, lanthanoids metal nitrate, and perchlorate complexes with ligand of various amines have been described in Chapters 8-10. In each group of compounds, the structural properties of the individual compounds are determined by gravimetric, IR and NMR studies. For those compounds which gave crystals, X-ray crystallography technique was undertaken to determine their structures. The results obtained from thermoanalytical and kinetic investigations related to the thermal decomposition, ignition/explosion and combustion of the compounds have also been described. The author hopes this book will be of interest to everyone involved with energetic materials irrespective of their background. This will prove useful to the serious college students as a text, to the engineers interested in the broad aspects of aerospace, and as an introduction to the propulsion of missiles or space vehicles. This book will be helpful to the people working in R&D laboratories, Universities, Institutes, Production agencies, Forensic laboratories, Armed forces (Army, Navy and Air Force), Quality assurance, Homeland securities, Chemical Industries etc. This book will be of immense use to organisations dealing with the production of commercial explosives and allied chemicals. It is hoped that this compilation of work will serve to stimulate more interest and promote further progress in the research into the properties and applications of these family of compounds reported in this book. This volume provides an overview of current research and recent advances in the area of energetic materials, focusing on explosives and propellants. The contents and format reflect the fact that theory, experiment and computation are closely linked in this field.

The challenge of developing energetic materials that are less sensitive to accidental stimuli continues to be of critical importance. This volume opens with discussions of some determinants of sensitivity and its correlations with various molecular and crystal properties. The next several chapters deal in considerable detail with different aspects and mechanisms of the initiation of detonation, and its quantitative description. The second half of this volume focuses upon combustion. Extensive studies model ignition and combustion, with applications to different propellants. The final chapter is an exhaustive computational treatment of the mechanism and kinetics of combustion initiation reactions of ammonium perchlorate. Overall, this volume illustrates the progress that has been made in the field of energetic materials and some of the areas of current activity. It also indicates the challenges involved in characterizing and understanding the properties and behaviour of these compounds. The work is a unique state-of-the-art treatment of the subject, written by pre-eminent researchers in the field. - Overall emphasis is on theory and computation, presented in the context of relevant experimental work - Presents a unique state-of-the-art treatment of the subject - Contributors are preeminent researchers in the field This book focuses on the combustion performance and application of innovative energetic materials for solid and hybrid space rocket propulsion. It provides a comprehensive overview of advanced technologies in the field of innovative energetic materials and combustion performance, introduces methods of modeling and diagnosing the aggregation/agglomeration of active energetic metal materials in solid propellants, and investigates the potential applications of innovative energetic materials in solid and hybrid propulsion. In addition,

it also provides step-by-step solutions for sample problems to help readers gain a good understanding of combustion performance and potential applications of innovative energetic materials in space propulsion. This book serves as an excellent resource for researchers and engineers in the field of propellants, explosives, and pyrotechnics. This comprehensive book presents a detailed account of research and recent developments in the field of green energetic materials, including pyrotechnics, explosives and propellants. This area is attracting increasing interest in the community as it undergoes a transition from using traditional processes, to more environmentally-friendly procedures. The book covers the entire line of research from the initial theoretical modelling and design of new materials, to the development of sustainable manufacturing processes. It also addresses materials that have already reached the production line, as well as considering future developments in this evolving field. David I.A. Millar's thesis explores the effects of extreme conditions on energetic materials. His study identifies and structurally characterises new polymorphs obtained at high pressures and/or temperatures. The performance of energetic materials (pyrotechnics, propellants and explosives) can depend on a number of factors including sensitivity to detonation, detonation velocity, and chemical and thermal stability. Polymorphism and solid-state phase transitions may therefore have significant consequences for the performance and safety of energetic materials. In order to model the behaviour of these important materials effectively under operational conditions it is essential to obtain detailed structural information at a range of temperatures and pressures. The 4th revised edition expands on the basic chemistry of high energy materials of the precious editions and examines new

research developments, including hydrodynamics and ionic liquids. Applications in military and civil fields are discussed. This work is of interest to advanced students in chemistry, materials science and engineering, as well as to all those working in defense technology. This book uses experimental and computational methods to rationalize and predict for the first time the relative impact sensitivities of a range of energetic materials. Using knowledge of crystal structures, vibrational properties, energy-transfer mechanisms, and experimentally measured sensitivities, it describes a model that leads to excellent correlation with experimental results in all cases. As such, the book paves the way for a new, fully ab initio approach for the design of safer energetic materials based solely on knowledge of their solid-state structures. Energetic materials (explosives, propellants, gas generators, and pyrotechnics) are defined as materials that release heat and/or gaseous products at a high rate upon stimulus by heat, impact, shock, sparks, etc. They have widespread military and civilian uses, including munitions, mining, quarrying, demolition, emergency signaling, automotive safety, and space exploration. One of their most important properties is sensitivity to accidental initiation during manufacture, transport, storage, and operation, which has important implications for their safe use. Energetic Nanomaterials: Synthesis, Characterization, and Application provides researchers in academia and industry the most novel and meaningful knowledge on nanoenergetic materials, covering the fundamental chemical aspects from synthesis to application. This valuable resource fills the current gap in book publications on nanoenergetics, the energetic nanomaterials that are applied in explosives, gun and rocket propellants, and pyrotechnic

devices, which are expected to yield improved properties, such as a lower vulnerability towards shock initiation, enhanced blast, and environmentally friendly replacements of currently used materials. The current lack of a systematic and easily available book in this field has resulted in an underestimation of the input of nanoenergetic materials to modern technologies. This book is an indispensable resource for researchers in academia, industry, and research institutes dealing with the production and characterization of energetic materials all over the world. Written by high-level experts in the field of nanoenergetics Covers the hot topic of energetic nanomaterials, including nanometals and their applications in nanoexplosives Fills a gap in energetic nanomaterials book publications Provides a hands-on approach to demilitarization and environmental aspects of energetic materials and munitions This book gives an overview of the environmental impact of the production, use, and cleanup of energetic materials and munitions. It provides scientists, engineers, environmental specialists, and users with the understanding of environmental issues for munitions and of the ways to improve design and manage potential risks. It covers the various aspects of how chemical properties influence fate, transport, and toxicity of new formulations and prescribes tools for reducing or alleviating environmental risks. In addition, it discusses pyrotechnics and the problem of dealing with munitions underwater. Chapters in Energetic Materials and Munitions: Life Cycle Management, Environmental Impact and Demilitarization look at demilitarization in general, as well as in the future. Topics covered include logistics, costs, and management; life cycle analysis and management; and greener munitions. Another introduces readers to the "One Health" approach in the design of

sustainable munition compounds. Following that, readers are taught about land assessment for munitions-related contamination in military live-fire training. The book also examines the development and integration of environmental, safety, and occupational health information. -Brings together in one source expertise and in-depth information on the current and future state of how we handle the production, use, and demilitarization of explosives and weaponry -A handy reference for experienced practitioners, as well as for training young professionals in the field -Every chapter contains real-life examples and proposes future directions for the field Energetic Materials and Munitions: Life Cycle Management, Environmental Impact and Demilitarization is an important book for explosives specialists, pyrotechnicians, materials scientists, military authorities, safety officers, health officers, and chemical engineers. In the last decade, there has been an influx in the development of new technologies for deep space exploration. Countries all around the world are investing in resources to create advanced energetic materials and propulsion systems for their aerospace initiatives. Energetic Materials Research, Applications, and New Technologies is an essential reference source of the latest research in aerospace engineering and its application in space exploration. Featuring comprehensive coverage across a range of related topics, such as molecular dynamics, rocket engine models, propellants and explosives, and quantum chemistry calculations, this book is an ideal reference source for academicians, researchers, advanced-level students, and technology developers seeking innovative research in aerospace engineering. Energetic materials are distinguished from other materials primarily by the fact that rapid, exothermic reactions can be

induced with the release of gaseous products. This complex phenomenon cuts across many boundaries of chemistry (synthesis, kinetics, thermodynamics, spectroscopy, quantum and molecular dynamics calculations, etc.) and engineering physics (shock and detonation waves, hydrodynamics, fracture and solid mechanics, defects, etc.). This volume offers the latest chemistry advancements in understanding the complex dynamic processes in these materials in the condensed phase. The focus is on fundamental research into the rates and pathways of rapid exothermic reactions, product specification, diagnostic methods, molecular processes of energy transfer, and molecular processes at extreme pressure and temperature. Many novel materials are discussed. The strict safety requirements associated with experimental studies of energetic materials warrant a computer-aided approach for the investigation and design of safe and powerful explosives or propellants. Models must therefore be developed to allow evaluation of significant properties from the structure of constitutive molecules. Much recent effort has been put into modeling sensitivities, with most work focusing on impact sensitivity, leading to a lot of experimental data in this area. Modern machine learning techniques, new physics-based models, and new reactive molecular dynamics and multiscale simulation methods have subsequently led to quantitative procedures applicable to large datasets and yielded valuable insight into the underlying initiation mechanisms. Molecular Modeling of the Sensitivities of Energetic Materials highlights these latest developments. Beginning with an introduction to experimental aspects in Part I, Parts II and III then explore relationships between sensitivity, molecular structure, and crystal structure, before going on to discuss insights from numerical simulations in Part IV. Part V then highlights applications of

these approaches to the design of new materials. Providing practical guidelines for implementing predictive models and their application to the search for new compounds, Molecular Modeling of the Sensitivities of Energetic Materials is an authoritative guide to this exciting field of research. Highlights a range of approaches for computational simulation and the importance of combining these to accurately understand or estimate different parameters Provides an overview of experimental findings and knowledge in a quick, accessible format Presents guidelines to implement sensitivity models using open-source python-related software, supporting easy implementation of flexible models, and allowing fast assessment of hypotheses This up-to-date overview provides the latest information on the performance, sensitivity, strength and processability aspects of propellants and explosive formulations, with the nature of polymer binder/plasticizer as the variable factor. Apart from applications, this monograph explores the principles behind energetic polymers, while discussing the synthetic routes and energetic characteristics of individual family of energetic polymers. Furthermore, a number of case studies illustrate the role of energetic polyerms on enhancing the performance of formulations as compared to their inert counterparts. The emphasis is on safety throughout, with practical guidance on how to safely handle and formulate energetic polymer based formulations. With the advent of a new generation of energetic polymers, this book is relevant to industry and defense organizations as well as for academic research. For a chemist who is concerned with the synthesis of new energetic compounds, it is essential to be able to assess physical and thermodynamic properties, as well as the sensitivity, of possible new energetic compounds before synthesis is attempted. Various approaches

have been developed to predict important aspects of the physical and thermodynamic properties of energetic materials including (but not limited to): crystal density, heat of formation, melting point, enthalpy of fusion and enthalpy of sublimation of an organic energetic compound. Since an organic energetic material consists of metastable molecules capable of undergoing very rapid and highly exothermic reactions, many methods have been developed to estimate the sensitivity of an energetic compound with respect to detonationcausing external stimuli such as heat, friction, impact, shock and electrostatic discharge. This book introduces these methods and demonstrates those methods which can be easily applied. Developed and expanded from the work presented at the New Energetic Materials and Propulsion Techniques for Space Exploration workshop in June 2014, this book contains new scientific results, up-to-date reviews, and inspiring perspectives in a number of areas related to the energetic aspects of chemical rocket propulsion. This collection covers the entire life of energetic materials from their conceptual formulation to practical manufacturing; it includes coverage of theoretical and experimental ballistics, performance properties, as well as laboratory-scale and full system-scale, handling, hazards, environment, ageing, and disposal. Chemical Rocket Propulsion is a unique work, where a selection of accomplished experts from the pioneering era of space propulsion and current technologists from the most advanced international laboratories discuss the future of chemical rocket propulsion for access to, and exploration of, space. It will be of interest to both postgraduate and final-year undergraduate students in aerospace engineering, and practicing aeronautical engineers and designers, especially those with an interest in propulsion, as well

as researchers in energetic materials. Advanced energetic materialsâ€"explosive fill and propellantsâ€"are a critical technology for national security. While several new promising concepts and formulations have emerged in recent years, the Department of Defense is concerned about the nationâ€™s ability to maintain and improve the knowledge base in this area. To assist in addressing these concerns, two offices within DOD asked the NRC to investigate and assess the scope and health of the U.S. R&D efforts in energetic materials. This report provides that assessment. It presents several findings about the current R&D effort and recommendations aimed at improving U.S. capabilities in developing new energetic materials technology. This study reviewed U.S. research and development in advanced energetics being conducted by DoD, the DoE national laboratories, industries, and academia, from a list provided by the sponsors. It also: (a) reviewed papers and technology assessments of non-U.S. work in advanced energetics, assessed important parameters, such as validity, viability, and the likelihood that each of these materials can be produced in quantity; (b) identified barriers to scale-up and production, and suggested technical approaches for addressing potential problems; and (c) suggested specific opportunities, strategies, and priorities for government sponsorship of technologies and manufacturing process development. This book offers a comprehensive account of energetic materials, including their synthesis, computational modeling, applications, associated degradation mechanisms, environmental consequences and fate and transport. This multi-author contributed volume describes how armed forces around the world are moving their attention from legacy explosive compounds, which are heat and shock sensitive (thus posing greater challenges in terms of handling and storage),

to the insensitive munitions compounds/formulations such as insensitive munitions explosive (IMX) and the Picatinny Arsenal Explosive (PAX) series of compounds. The description of energetic materials focuses on explosives, pyrotechnic compositions, and propellants. The contributors go on to explain how modern generation energetic compounds must be insensitive to shock and heat but at the same time yield more energy upon explosion. Nanoinspired and/or co-crystallized energetic materials offer another route to generate next-generation energetic materials, and this authoritative book bridges a large gap in the literature by providing a comprehensive analysis of these compounds. Additionally, it includes a valuable overview of energetic materials, a detailed discussion of recent advances on future energetic compounds, nanotechnology in energetic materials, environmental contamination and toxicity, assessment of munitions lethality, the application quantitative structure–activity relationship (QSAR) in design of energetics and the fate and transport of munition compounds in the environment. Heat flow calorimetry using microcalorimeters and other instruments such as DSC and ARC has proven to be a very helpful and suitable tool in assessing the thermal behaviour of energetic materials as regards their to safety, decomposition kinetics, reaction behaviour, performance, in-service time prediction and other aspects. Energetic materials comprise propellants, explosives, gas generators, pyrotechnics and energetic chemicals in industrial use. The 6th HFCS-EM held from May 6th to 8th, 2008 at Fraunhofer ICT is an international forum of experts coming from fifteen countries all over the world. This book contains all the contributions to the Symposium. Beside this printed proceedings a CD is also available covering the same content in electronic form. This may help to use the

lectures more conveniently in daily work at home. But during the Symposium printed proceedings support the discussions and the uptake of the lectures. Incorporation of particular components with specialized properties allows one to tailor the end product's properties. For instance, the sensitivity, burning behavior, thermal or mechanical properties or stability of energetic materials can be affected and even controllably varied through incorporation of such ingredients. This book examines particle technologies as applied to energetic materials such as propellants and explosives, thus filling a void in the literature on this subject. Following an introduction covering general features of energetic materials, the first section of this book describes methods of manufacturing particulate energetic materials, including size reduction, crystallization, atomization, particle formation using supercritical fluids and microencapsulation, agglomeration phenomena, special considerations in mixing explosive particles and the production of nanoparticles. The second section discusses the characterization of particulate materials. Techniques and methods such as particle size analysis, morphology elucidation and the determination of chemical and thermal properties are presented. The wettability of powders and rheological behavior of suspensions and solids are also considered. Furthermore, methods of determining the performance of particular energetic materials are described. Each chapter deals with fundamentals and application possibilities of the various methods presented, with particular emphasis on issues applicable to particulate energetic materials. The book is thus equally relevant for chemists, physicists, material scientists, chemical and mechanical engineers and anyone interested or engaged in particle processing and characterization technologies.

Green Energy Materials Handbook gives a systematic review of the development of reliable, low-cost, and high-performance green energy materials, covering mainstream computational and experimental studies as well as comprehensive literature on green energy materials, computational methods, experimental fabrication and characterization techniques, and recent progress in the field. This work presents complete experimental measurements and computational results as well as potential applications. Among green technologies, electrochemical and energy storage technologies are considered as the most practicable, environmentally friendly, and workable to make full use of renewable energy sources. This text includes 11 chapters on the field, devoted to 4 important topical areas: computational material design, energy conversion, ion transport, and electrode materials. This handbook is aimed at engineers, researchers, and those who work in the fields of materials science, chemistry, and physics. The systematic studies proposed in this book can greatly promote the basic and applied sciences. This third edition of the classic on the thermochemical aspects of the combustion of propellants and explosives is completely revised and updated and now includes a section on green propellants and offers an up-to-date view of the thermochemical aspects of combustion and corresponding applications. Clearly structured, the first half of the book presents an introduction to pyrodynamics, describing fundamental aspects of the combustion of energetic materials, while the second part highlights applications of energetic materials, such as propellants, explosives and pyrolants, with a focus on the phenomena occurring in rocket motors. Finally, an appendix gives a brief overview of the fundamentals of aerodynamics and heat transfer, which is a prerequisite for the study of

pyrodynamics. A detailed reference for readers interested in rocketry or explosives technology. Materials for Energy offers a comprehensive overview of the latest developments in materials for efficient and sustainable energy applications, including energy conversion, storage, and smart applications. Discusses a wide range of material types, such as nanomaterials, carbonaceous electrocatalysts and electrolytes, thin films, phase change materials, 2D energy materials, triboelectric materials, and membrane materials Describes applications that include flexible energy storage devices, sensors, energy storage batteries, fuel and solar cells, photocatalytic wastewater treatment, and more Highlights current developments in energy conversion, storage, and applications from a materials angle Aimed at researchers, engineers, and technologists working to solve alternative energy issues, this work illustrates the state of the art and latest technologies in this important field. The study of energetic materials is emerging from one primarily directed toward practical interests to an advanced area of fundamental research, where state-of-the-art methods and theory are used side by side with modern synthetic methods. This timely book integrates the recent experimental, synthetic, and theoretical research of energetic materials. Editors George Olah and David Squire emphasize the importance of structure and mechanism in determining properties and performances. They also explore new spectrometric methods and synthetic approaches in this useful reference. Discusses structural analysis by x-ray crystallography Explains chemical dynamics by photofragmentation translational spectroscopy Covers kinetic analysis by ultrafast absorption and emission spectroscopy Details syntheses of polycyclic caged amines, fuel additives, and

polynitro compounds Examines computer-aided design of monopropellants Includes contributions by two Nobel laureates and five members of the National Academy of Sciences This book presents the latest research on the area of nano-energetic materials, their synthesis, fabrication, patterning, application and integration with various MEMS systems and platforms. Keeping in mind the applications for this field in aerospace and defense sectors, the articles in this volume contain contributions by leading researchers in the field, who discuss the current challenges and future perspectives. This volume will be of use to researchers working on various applications of high-energy research. Authored by an insider with over 40 years of high energy materials (HEMs) experience in academia, industry and defense organizations, this handbook and ready reference covers all important HEMs from the 1950s to the present with their respective properties and intended purposes. Written at an attainable level for professionals, engineers and technicians alike, the book provides a comprehensive view of the current status and suggests further directions for research and development. An introductory chapter on the chemical and thermodynamic basics allows the reader to become acquainted with the fundamental features of explosives, before moving on to the important safety aspects in processing, handling, transportation and storage of high energy materials. With its collation of results and formulation strategies hitherto scattered in the literature, this should be on the shelf of every HEM researcher and developer. Energy Materials: A Short Introduction to Functional Materials for Energy Conversion and Storage provides readers with an accessible overview of the functional materials currently employed or investigated for energy provision, conversion, and storage. Rather than

exploring the physical and chemical basics of energy conversion and storage, this book focuses on the various materials used in this field with simple explanations of their design principles, specific functionality, and quantitative figures of merit. It is suited for advanced undergraduate and graduate students studying energy and energy materials in physics, material science, engineering, and chemistry courses, as well as scientists starting their research in the field of functional materials for energy applications. Key Features: Provides an accessible introduction to complex subjects in simple terms with pedagogical features to enhance learning Contains the latest developments in this exciting and growing area Discusses examples from modern high-impact research and applications For a chemist who is concerned with the synthesis of new energetic compounds, it is essential to be able to assess physical and thermodynamic properties, as well as the sensitivity, of possible new energetic compounds before synthesis is attempted. Various approaches have been developed to predict important aspects of the physical and thermodynamic properties of energetic materials including (but not limited to): crystal density, heat of formation, melting point, enthalpy of fusion and enthalpy of sublimation of an organic energetic compound. Since an organic energetic material consists of metastable molecules capable of undergoing very rapid and highly exothermic reactions, many methods have been developed to estimate the sensitivity of an energetic compound with respect to detonationcausing external stimuli such as heat, friction, impact, shock and electrostatic discharge. This book introduces these methods and demonstrates those methods which can be easily applied. This book represents a collection of lectures presented at the NATO Advanced study Institute(ASI) on "Chemistry &

Physics of the Molecular Processes in Energetic Materials", held at Hotel Torre Normanna, Altavilla Milicia, Sicily, Italy, September 3 to 15, 1989. The institute was attended by seventy participants including twenty lecturers, drawn from thirteen countries. The purpose of the institute was to review the major ad vances made in recent years in the theoretical and experi mental aspects of explosives and propellants. In accordance with the format of the NATO ASI, it was arranged to have a relatively small number of speakers to present in depth, re view type lectures emphasizing the basic research aspects of the subject, over a two week period. Most of the speakers gave two lectures, each in excess of one hour with addition al time for discussions. The scope of the meeting was limit ed to molecular and spectroscopic studies since the hydro dynamic aspects of detonation and various performance crite ria of energetic materials are often covered adequately in other international meetings. An attempt was made to have a coherent presentation of various theoretical, computational and spectroscopic approaches to help a better understanding of energetic materials from a molecular point of view. The progress already made in these areas is such that structure property (e. g. This book discusses methods for the assessment of energetic compounds through heat of detonation, detonation pressure, velocity and temperature, Gurney energy and power. The authors focus on the detonation pressure and detonation velocity of non-ideal aluminized energetic compounds. This 2nd Edition includes an updated and improved presentation of simple, reliable methods for the design, synthesis and development of novel energetic compounds. Multi-component crystalline systems or co-crystals have received tremendous attention from academia and industry alike in the past decade. Applications

of co-crystals are varied and are likely to positively impact a wide range of industries dealing with molecular solids. Co-crystallization has been used to improve the properties and performance of materials from pharmaceuticals to energetic materials, as well as for separation of compounds. This book combines co-crystal applications of commercial and practical interest from diverse fields in to a single volume. It also examines effective structural design of co-crystals, and provides insights into practical synthesis and characterization techniques. Providing a useful resource for postgraduate students new to applied co-crystal research and crystal engineering, it will also be of interest to established researchers in academia or industry. The development, processing, and lifecycle environmental impact analysis of energetic materials all pose various challenges and potential dangers. Because safety concerns severely limit study of these substances at most research facilities, engineers will especially appreciate a tool that strengthens understanding of the chemistry and physics involved and helps them better predict how these materials will behave when used in explosives, propellants, pyrotechnics, and other applications. Integrate Cutting-Edge Research Sponsored by the U.S. Department of Defense Energetic Materials: Thermophysical Properties, Predictions, and Experimental Measurements covers a variety of advanced empirical modeling and simulation tools used to explore development, performance, sensitivity, and lifecycle issues of energetic materials. Focusing on a critical component of energetic materials research— prediction of thermophysical properties—this book elucidates innovative and experimental techniques being used to: Apply molecular and meso-scale modeling methodologies to measure reactivity, performance, and properties of new energetic materials Gain insight into

shear initiation at the particulate level Better understand the fate, transport, and overall environmental impact of energetic materials Evaluate the performance of new materials and assess their reaction mechanisms Edited by two respected U.S. Army engineers, this book highlights cutting-edge research from leaders in the energetics community. Documenting the history, applications, and environmental behavior of energetic materials, this reference is a valuable resource for anyone working to optimize their massive potential—either now or in the future. This book summarizes science and technology of a new generation of high-energy andinsensitive explosives. The objective is to provide professionals with comprehensiveinformation on the synthesis and the physicochemical and detonation properties ofthe explosives. Potential technologies applicable for treatment of contaminated wastestreams from manufacturing facilities and environmental matrices are also be included.This book provides the reader an insight into the depth and breadth of theoreticaland empirical models and experimental techniques currently being developed in thefield of energetic materials. It presents the latest research by DoD engineers andscientists, and some of DoD’s academic and industrial researcher partners. The topicsexplored and the simulations developed or modified for the purposes of energetics mayfind application in other closely related fields, such as the pharmaceutical industry.One of the key features of the book is the treatment of wastewaters generated duringmanufacturing of these energetic materials.

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