

James N. Johnson  
Roger Chéret  
Editors

# Classic Papers in Shock Compression Science



Springer

# Classic Papers In Shock Compression Science Shock Wave And High Pressure Phenomena

**Achim M. Loske**



## **Classic Papers In Shock Compression Science Shock Wave And High Pressure Phenomena:**

**Classic Papers in Shock Compression Science** James N. Johnson, Roger Cheret, 1998-06-02 This collection of classic papers in shock compression science makes available not only some of the most important classic papers on shock waves by Poisson Rankine Earnshaw Riemann and Hugoniot which remain important references but also some pathbreaking papers from the 1940s and 1950s on shocks in solids and fluids by such theorists as Bethe and Weyl Although their ideas and results remain of current interest many of these papers have been hard to find since the journals in which they were published are not available in many libraries The editors have also translated papers written in French to make them accessible to a wider audience This collection is thus not only a valuable historical resource but also a vital reference for those working in the field

**Classic Papers in Shock Compression Science** James N Johnson, Roger Cheret, 1998-06-02      **Fundamentals of Shock Wave Propagation in Solids** Lee Davison, 2008-05-07 My intent in writing this book is to present an introduction to the thermo chanical theory required to conduct research and pursue applications of shock physics in solid materials Emphasis is on the range of moderate compression that can be produced by high velocity impact or detonation of chemical exp sives and in which elastoplastic responses are observed and simple equations of state are applicable In the interest of simplicity the presentation is restricted to plane waves producing uniaxial deformation Although applications often involve complex multidimensional deformation fields it is necessary to begin with the simpler case This is also the most important case because it is the usual setting of experimental research The presentation is also restricted to theories of material response that are simple enough to permit illustrative problems to be solved with minimal recourse to numerical analysis The discussions are set in the context of established continuum mechanical principles I have endeavored to define the quantities encountered with some care and to provide equations in several convenient forms and in a way that lends itself to easy reference Thermodynamic analysis plays an important role in continuum mechanics and I have included a presentation of aspects of this subject that are particularly relevant to shock physics The notation adopted is that conventional in expositions of modern continuum mechanics insofar as possible and variables are explained as they are encountered Those experienced in shock physics may find some of the notation unconventional      Shock Wave Reflection Phenomena Gabi

Ben-Dor, 2007-08-28 This book is a comprehensive state of the knowledge summation of shock wave reflection phenomena from a phenomenological point of view It includes a thorough introduction to oblique shock wave reflections dealing with both regular and Mach types It also covers in detail the corresponding two and three shock theories The book moves on to describe reflection phenomena in a variety of flow types as well as providing the resolution of the Neumann paradox

*Shock Wave Compression of Condensed Matter* Jerry W Forbes, 2013-02-01 This book introduces the core concepts of the shock wave physics of condensed matter taking a continuum mechanics approach to examine liquids and isotropic solids The text primarily focuses on one dimensional uniaxial compression in order to show the key features of condensed matter s

response to shock wave loading The first four chapters are specifically designed to quickly familiarize physical scientists and engineers with how shock waves interact with other shock waves or material boundaries as well as to allow readers to better understand shock wave literature use basic data analysis techniques and design simple 1 D shock wave experiments This is achieved by first presenting the steady one dimensional strain conservation laws using shock wave impedance matching which insures conservation of mass momentum and energy Here the initial emphasis is on the meaning of shock wave and mass velocities in a laboratory coordinate system An overview of basic experimental techniques for measuring pressure shock velocity mass velocity compression and internal energy of steady 1 D shock waves is then presented In the second part of the book more advanced topics are progressively introduced thermodynamic surfaces are used to describe equilibrium flow behavior first order Maxwell solid models are used to describe time dependent flow behavior descriptions of detonation shock waves in ideal and non ideal explosives are provided and lastly a select group of current issues in shock wave physics are discussed in the final chapter

**Shock-Wave Phenomena and the Properties of Condensed Matter** Gennady I. Kanel, Sergey V. Razorenov, Vladimir E. Fortov, 2013-06-29 One of the main goals of investigations of shock wave phenomena in condensed matter is to develop methods for predicting effects of explosions high velocity collisions and other kinds of intense dynamic loading of materials and structures Based on the results of international research conducted over the past 30 years this book is addressed not only to experts in shock wave physics but also to interested representatives from adjacent fields of activity and to students who seek an introduction to the current issues With that goal in mind the book opens with a brief account of the theoretical background and a short description of experimental techniques The authors then progress to a systematic treatment of special topics some of which have not been fully addressed in the literature to date

*Shock Phenomena in Granular and Porous Materials* Tracy J. Vogler, D. Anthony Fredenburg, 2019-09-04 Granular forms of common materials such as metals and ceramics sands and soils porous energetic materials explosives reactive mixtures and foams exhibit interesting behaviors due to their heterogeneity and critical length scale typically commensurate with the grain or pore size Under extreme conditions of impact granular and porous materials display highly localized phenomena such as fracture inelastic deformation and the closure of voids which in turn strongly influence the bulk response Due to the complex nature of these interactions and the short time scales involved computational methods have proven to be powerful tools to investigate these phenomena Thus the coupled use of experiment theory and simulation is critical to advancing our understanding of shock processes in initially porous and granular materials This is a comprehensive volume on granular and porous materials for researchers working in the area of shock and impact physics The book is divided into three sections where the first presents the fundamentals of shock physics as it pertains to the equation of state compaction and strength properties of porous materials Building on these fundamentals the next section examines several applications where dynamic processes involving initially porous materials are prevalent focusing on the areas of penetration planetary impact and

reactive munitions The final section provides a look at emerging areas in the field where the expansion of experimental and computational capabilities are opening the door for new opportunities in the areas of advanced light sources molecular dynamics modeling and additively manufactured porous structures By intermixing experiment theory and simulation throughout this book serves as an excellent up to date desk reference for those in the field of shock compression science of porous and granular materials     Static Compression of Energetic Materials Suhithi M. Peiris,Gasper J.

Piermarini,2009-01-03 Developing and testing novel energetic materials is an expanding branch of the materials sciences Reaction detonation or explosion of such materials invariably produce extremely high pressures and temperatures To study the equations of state EOS of energetic materials in extreme regimes both shock and static high pressure studies are required The present volume is an introduction and review of theoretical experimental and numerical aspects of static compression of such materials Chapter 1 introduces the basic experimental tool the diamond anvil pressure cell and the observational techniques used with it such as optical microscopy infrared spectrometry and x ray diffraction Chapter 2 outlines the principles of high nitrogen energetic materials synthesis Chapters 3 and 4 examine and compare various EOS formalisms and data fitting for crystalline and non crystalline materials respectively Chapter 5 details the reaction kinetics of detonating energetic materials Chapter 6 investigates the interplay between static and dynamic shock studies Finally Chapters 7 and 8 introduce numerical simulations molecular dynamics of energetic materials under either hydrostatic or uni axial stress and ab initio treatments of defects in crystalline materials This timely volume meets the growing demand for a state of the art introduction and review of the most relevant aspects of static compression of energetic materials and will be a valuable reference to researchers and scientists working in academic industrial and governmental research laboratories

**Detonation Phenomena of Condensed Explosives** Shiro Kubota,2023-01-13 This book presents fundamental theory of shock and detonation waves as well as selected studies in detonation research in Japan contributed by selected experts in safety research on explosives development of industrial explosives and application of explosives It also reports detonation research in Japan featuring industrial explosives that include ammonium nitrate based explosives and liquid explosives Intended as a monographic style book it consistently uses technical terms and symbols and creates organic links between various detonation phenomena in application of explosives fundamental theory of detonation waves measurement methods and individual studies Among other features the book presents a historical perspective of shock wave and detonation research in Japan pedagogical materials for young researchers in detonation physics and an introduction to works in Japan including equations of state which are worthy of attention but about which very little is known internationally Further the concise pedagogical chapters also characterize this book as a primer of detonation of condensed explosives and help readers start their own research     Blast Waves Charles E. Needham,2010-03-17 As an editor of the international scientific journal Shock Waves I was asked whether I might document some of my experience and knowledge in the field of blast waves I began

an outline for a book on the basis of a short course that I had been teaching for several years I added to the outline filling in details and including recent developments especially in the subjects of height of burst curves and nonideal explosives At a recent meeting of the International Symposium on the Interaction of Shock Waves I was asked to write the book I had said I was working on As a senior advisor to a group working on computational fluid dynamics I found that I was repeating many useful rules and conservation laws as new people came into the group The transfer of knowledge was hit and miss as questions arose during the normal work day Although I had developed a short course on blast waves it was not practical to teach the full course every time a new member was added to the group This was sufficient incentive for me to undertake the writing of this book I cut my work schedule to part time for two years while writing the book This allowed me to remain heavily involved in ongoing and leading edge work in hydrodynamics while documenting this somewhat historical perspective on blast waves

Medical and Biomedical Applications of Shock Waves Achim M. Loske, 2016-12-01 This book provides current comprehensive and clear explanations of the physics behind medical and biomedical applications of shock waves Extracorporeal shock wave lithotripsy is one of the greatest medical advances of our time and its techniques and clinical devices are continuously evolving Further research continues to improve the understanding of calculi fragmentation and tissue damaging mechanisms Shock waves are also used in orthopedics and traumatology Possible applications in oncology cardiology dentistry gene therapy cell transfection transformation of fungi and bacteria as well as the inactivation of microorganisms are promising approaches for clinical treatment industrial applications and research Medical and Biomedical Applications of Shock Waves is useful as a guide for students technicians and researchers working in universities and laboratories Chemists biologists physicians and veterinarians involved in research or clinical practice will find useful advice but also engineers and physicists may benefit from the overview of current research endeavors and future directions Furthermore it may also serve to direct manufacturers towards the design of more efficient and safer clinical industrial and laboratory equipment

*Shock Fitting* Marcello Onofri, Renato Paciorri, 2017-11-18 This book describes the revolutionary capabilities of new shock fitting algorithms a great improvement in computational fluid dynamics CFD for high speed numerical simulations Shock fitting methods provide a solution to the current difficulties and inaccuracies in shock capturing approaches This work traces the evolution of shock fitting methods from the pioneering methods based on the structured grids boundary and floating shock fitting to recent developments on unstructured grids illustrating algorithmic details significant applications and potential developments Also to celebrate the centenary birth of the father of shock fitting techniques the book also includes a tribute to Gino Moretti as well as his unpublished manuscript This book will appeal to professionals researchers and graduate students in the field of CFD

*Introduction to Simple Shock Waves in Air* Seán Prunty, 2018-12-13 This book provides an elementary introduction to some one dimensional fluid flow problems involving shock waves in air The differential equations of fluid flow are approximated by finite difference equations and these in turn

are numerically integrated in a stepwise manner Artificial viscosity is introduced into the numerical calculations in order to deal with shocks The presentation is restricted to the finite difference approach to solve the coupled differential equations of fluid flow as distinct from finite volume or finite element methods This text presents the results arising from the numerical solution using Mathcad programming Both plane and spherical shock waves are discussed with particular emphasis on very strong explosive shocks in air This text will appeal to students researchers and professionals in shock wave research and related fields Students in particular will appreciate the benefits of numerical methods in fluid mechanics and the level of presentation

**High-Pressure Shock Compression of Solids VII** Vladimir E. Fortov, L.V. Altshuler, R.F. Trunin, A.I. Funtikov, 2013-03-09 Presenting some of the most recent results of Russian research into shock compression as well as historical overviews of the Russian research programs into shock compression this volume will provide Western researchers with many novel ideas and points of view The chapters in this volume are written by leading Russian specialists various fields of high pressure physics and form accounts of the main researches on the behavior of matter under shock wave interaction The experimental portions contain results of studies of shock compression of metals to high and ultra high pressure shock initiation of polymorphic transformations strength fracture and fragmentation under shock compression and detonation of condensed explosives There are also chapters on theoretical investigations of shock wave compression and plasma states in regimes of high pressure and high temperature The topics of the book are of interest to scientists and engineers concerned with questions of material behavior under impulsive loading and to the equation of state of matter Application is to questions of high speed impact inner composition of planets verification of model representations of material behavior under extreme loading conditions syntheses of new materials development of new technologies for material processing etc Russian research differs from much of the Western work in that it has traditionally been wider ranging and more directed to extremes of response than to precise characterization of specific materials and effects Western scientists could expect to benefit from the perspective gained from close knowledge of the Russian work

**Nonlinear Elastic and Inelastic Models for Shock Compression of Crystalline Solids** John D. Clayton, 2019-05-17 This book describes thermoelastic and inelastic deformation processes in crystalline solids undergoing loading by shock compression Constitutive models with a basis in geometrically nonlinear continuum mechanics supply these descriptions Large deformations such as finite strains and rotations are addressed The book covers dominant mechanisms of nonlinear thermoelasticity dislocation plasticity deformation twinning fracture flow and other structure changes Rigorous derivations of theoretical results are provided with approximately 1300 numbered equations and an extensive bibliography of over 500 historical and modern references spanning from the 1920s to the present day Case studies contain property data as well as analytical and numerical solutions to shock compression problems for different materials Such materials are metals ceramics and minerals single crystalline and polycrystalline The intended audience of this book is practicing scientists physicists engineers materials scientists and

applied mathematicians involved in advanced research on shock compression of solid materials

**High-Pressure Shock Compression of Solids VIII** L.C. Chhabildas, Lee Davison, Y. Horie, 2006-03-30 Research in the field of shock physics and ballistic impact has always been intimately tied to progress in development of facilities for accelerating projectiles to high velocity and instrumentation for recording impact phenomena The chapters of this book written by leading US and European experts cover a broad range of topics and address researchers concerned with questions of material behaviour under impulsive loading and the equations of state of matter as well as the design of suitable instrumentation such as gas guns and high speed diagnostics Applications include high speed impact dynamics the inner composition of planets syntheses of new materials and materials processing Among the more technologically oriented applications treated is the testing of the flight characteristics of aeroballistic models and the assessment of impacts in the aerospace industry

**History of Shock Waves, Explosions and Impact** Peter O. K. Krehl, 2008-09-24 This unique and encyclopedic reference work describes the evolution of the physics of modern shock wave and detonation from the earlier and classical percussion The history of this complex process is first reviewed in a general survey Subsequently the subject is treated in more detail and the book is richly illustrated in the form of a picture gallery This book is ideal for everyone professionally interested in shock wave phenomena

**Fragmentation of Rings and Shells** Dennis Grady, 2007-07-13 For a brief period during the latter part of World War II Nevill F Mott led a theoretical group at Fort Halstead in the United Kingdom that tackled scientific issues related to pressing war time concerns Among later awards and honors Mott was knighted and a recipient of the Nobel Prize While at Fort Halstead he undertook an effort to theoretically describe the statistical fragmentation of munitions subjected to intense explosive loading Mott's original internal reports contain seminal theoretical concepts on the physics and statistics of dynamic fracture and fragmentation which have provided the inspiration for numerous later modeling efforts and engineering formulae Some of his most forward looking thoughts on the micromechanical and molecular aspects of fracture are included in these publications The present book surveys the theoretical analysis put forth by Mott with particular focus on his efforts to characterize the size and distribution of fragments resulting from a dynamic fragmentation event Copies of the original internal reports of Mott and his co workers are included The book also pursues additional theoretical analysis with the intent of delving further into the physical ideas and unfinished analysis implicit in Mott's original studies This book will be of interest to all scientists and engineers concerned with the dynamic fracture and fragmentation of solid bodies subject to intense transient loads imparted by explosive detonation and high velocity impact from both the historical and modern perspective

**Detonation Control for Propulsion** Jiun-Ming Li, Chiang Juay Teo, Boo Cheong Khoo, Jian-Ping Wang, Cheng Wang, 2017-12-05 This book focuses on the latest developments in detonation engines for aerospace propulsion with a focus on the rotating detonation engine RDE State of the art research contributions are collected from international leading researchers devoted to the pursuit of controllable detonations for practical detonation propulsion A system level



design of novel detonation engines performance analysis and advanced experimental and numerical methods are covered In addition the world s first successful sled demonstration of a rocket rotating detonation engine system and innovations in the development of a kilohertz pulse detonation engine PDE system are reported Readers will obtain in a straightforward manner an understanding of the RDE PDE design operation and testing approaches and further specific integration schemes for diverse applications such as rockets for space propulsion and turbojet ramjet engines for air breathing propulsion Detonation Control for Propulsion Pulse Detonation and Rotating Detonation Engines provides with its comprehensive coverage from fundamental detonation science to practical research engineering techniques a wealth of information for scientists in the field of combustion and propulsion The volume can also serve as a reference text for faculty and graduate students and interested in shock waves combustion and propulsion Thermo-Gas Dynamics of Hydrogen Combustion and Explosion Boris E. Gelfand, Mikhail V. Silnikov, Sergey P. Medvedev, Sergey V. Khomik, 2012-02-13 The potential of hydrogen as an important future energy source has generated fresh interest in the study of hydrogenous gas mixtures Indeed both its high calorificity and reactivity are unique properties the latter underscoring safety considerations when handling such mixtures The present monograph is devoted to the various aspects of hydrogen combustion and explosion processes In addition to theoretical and phenomenological considerations this work also collates the results of many experiments from less well known sources The text reviews the literature in this respect thereby providing valuable information about the thermo gas dynamical parameters of combustion processes for selected experimental settings in a range of scientific and industrial applications

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