

**Solids Under High-Pressure
Shock Compression: Mechanics,
Physics and Chemistry
(High-pressure Shock
Compression of Condensed
Matter)**

Graham, R. A.

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Solids Under High Pressure Shock Compression Mechanics Physics And Chemistry

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Solids Under High-Pressure Shock Compression R.A. Graham, 2012-12-06 Since the 1950s shock compression research contributed greatly to scientific knowledge and industrial technology As a result for example our understanding of meteorite impacts has substantially improved and shock processes have become standard industrial methods in materials synthesis and processing Investigations of shock compressed matter involve physics electrical engineering solid mechanics metallurgy geophysics and materials science The description of shock compressed matter presented here which is derived from physical and chemical observations differs significantly from the classical descriptions derived from strictly mechanical characteristics This volume with over 900 references provides an introduction for scientists and engineers interested in the present state of shock compression science *High-Pressure Shock Compression of Solids* J.R. Asay, M.

Shahinpoor, 2012-12-06 This book presents a set of basic understandings of the behavior and response of solids to propagating shock waves The propagation of shock waves in a solid body is accompanied by large compressions decompression and shear Thus the shear strength of solids and any inelastic response due to shock wave propagation is of the utmost importance Furthermore shock compression of solids is always accompanied by heating and the rise of local temperature which may be due to both compression and dissipation For many solids under a certain range of impact pressures a two wave structure arises such that the first wave called the elastic precursor travels with the speed of sound and the second wave called a plastic shock wave travels at a slower speed Shock wave loading of solids is normally accomplished by either projectile impact such as produced by guns or by explosives The shock heating and compression of solids covers a wide range of temperatures and densities For example the temperature may be as high as a few electron volts 1 eV 11 500 K for very strong shocks and the densification may be as high as four times the normal density

High-Pressure Shock Compression of Solids IV Lee Davison, Y. Horie, Mohsen Shahinpoor, 2012-12-06 Much of the current interest in shock compression of porous solids stems from the desire to bond hard refractory powders into strong and dense solids However while much is known about the effects of shock compression on monolithic materials the unusual physical and chemical processes that take place when a porous medium is shocked have been little studied thus far This volume with contributions by leading researchers in condensed matter physics physical chemistry metallurgy mechanics and materials science begins to address that gap The focus is on heterogeneous deformation mechanisms nonequilibrium thermodynamics and chemical processes The contributions discuss such topics as modeling the complex interplay of thermal mechanical and chemical processes experimental data on pore collapse and their interpretation and synthesis of new materials through shock induced chemical reactions By presenting not only the most recent results but also the open questions that remain these essays convey the excitement of developing a scientific basis for understanding shock compression of highly porous solids Topics covered include Shock Compression Science in Highly Porous Solids Shock

Loading of Porous High Explosives Continuum Mixture Modeling of Reactive Porous Media Two Phase Media Model of Shock Compression with Chemical reaction Constitutive Modeling of Shock Induced Reactions in Powder Mixtures Discrete element Modeling of Shock Processes in Powders **Shock-Induced Chemistry** Toshimori Sekine, 2024-06-23 This book begins with the history and background of the subject and then describes key experimental methods Subsequent chapters are devoted to individual topics of chemistry and materials namely synthesis of hard materials ceramics at high pressure shock induced chemical operations biomolecules meteorites and metals and molecules under extreme conditions Lastly it offers applications to earth and planetary science and ends with future perspectives Shock waves dynamically produce high pressure and temperature conditions and offer interesting areas for studies on unique chemical reactions This book introduces readers to modern shock induced chemistry and its applications and provides an update of topics in that discipline Readers can gain a comprehensive understanding of current shock induced chemistry and its versatile applications

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 chemical 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 explosives 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**

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

, [Applied Mechanics of Polymers](#) George Youssef,2021-12-02 [Applied Mechanics of Polymers](#) Properties Processing and Behavior provides readers with an overview of the properties mechanical behaviors and modeling techniques for accurately predicting the behaviors of polymeric materials The book starts with an introduction to polymers covering their history chemistry physics and various types and applications In addition it covers the general properties of polymers and the common processing and manufacturing processes involved with them Subsequent chapters delve into specific mechanical behaviors of polymers such as linear elasticity hyperelasticity creep viscoelasticity failure and fracture The book concludes with chapters discussing electroactive polymers hydrogels and the mechanical characterization of polymers This is a useful reference text that will benefit graduate students postdocs researchers and engineers in the mechanics of materials polymer science mechanical engineering and material science Additional resources related to the book can be found at [polymersmechanics.com](#) Provides examples of real world applications that demonstrate the use of models in designing polymer based components Includes access to a companion site from where readers can download FEA and MATLAB code FEA simulation files videos and other supplemental material Features end of chapter summaries with design and analysis guidelines practice problem sets based on real life situations and both analytical and computational examples to bridge academic and industrial applications

Explosive Pulsed Power Larry L. Altgilbers,2011 Explosive pulsed power generators are devices that either convert the chemical energy stored in explosives into electrical energy or use the shock waves generated by explosives to release energy stored in ferroelectric and ferromagnetic materials The objective of this book is to acquaint the reader with the principles of operation of explosive generators and to provide details on how to design build and test three types of generators flux compression ferroelectric and ferromagnetic generators which are the most developed and the most near term for practical applications Containing a considerable amount of new experimental data that has been collected by the authors this is the first book that treats all three types of explosive pulsed power generators In addition there is a brief introduction to a fourth type ix explosive generator called a moving magnet generator As practical applications for these generators evolve students scientists and engineers will have access to the results of a considerable body of experience gained by almost 10 years of intense research and development by the authors

Advances in Chemical Physics, Volume 131 Stuart A. Rice, 2005-07-13 This series provides the chemical physics field with a forum for critical authoritative evaluations of advances in every area of the discipline Volume 131 includes chapters on Polyelectrolyte Dynamics Hydrodynamics and Slip at the Liquid Solid Interface Structure of Ionic Liquids and Ionic Liquid Compounds Are Ionic Liquids Genuine Liquids in the Conventional Sense Chemical Reactions at Very High Pressure Classical Description of Nonadiabatic Quantum Dynamics and Non Born Oppenheimer Variational Calculations of Atoms and Molecules with Explicitly Correlated Gaussian Basis Functions

Dynamic Deformation, Damage and Fracture in Composite Materials and Structures Vadim Silberschmidt, 2022-09-15 Dynamic Deformation Damage and Fracture in Composite Materials and Structures Second Edition reviews various aspects of dynamic deformation damage and fracture mostly in composite laminates and sandwich structures and in a broad range of application areas including aerospace automotive defense and sports engineering This book examines low and high velocity loading and assesses shock blast and penetrative events and has been updated to cover important new developments such as the use of additive manufacturing to produce composites including fiber reinforced ones New microstructural experimental theoretical and numerical studies with advanced tools are included as well The book also features four new chapters covering topics such as dynamic delamination dynamic deformation and fracture in 3D printed composites ballistic impacts with fragmenting projectiles and the effect of multiple impacting Examines dynamic deformation and fracture of composite materials covering experimental analytical and numerical aspects Features four new chapters covering topics such as dynamic interfacial fracture fracture in 3D printed composites ballistic impacts with fragmenting projectiles and the effect of multiple impacting Addresses important application areas such as aerospace automotive wind energy defense and sports

Shock and Materials Stepan S. Batsanov, 2018-03-17 This book highlights how the properties and structure of materials are affected by dynamic high pressures generated by explosions projectile impacts laser compression electric discharge or ball milling Starting with the basics of shock wave physics and an outline of experimental techniques it then surveys dynamic compressibility and equations of state of various substances phase transitions and syntheses of novel compounds under shock It covers various industrial applications including hardening of metals and grinding fragmentation of solids saturation of solids with defects for use as catalysts production of superhard materials synthetic diamond BN boron nitride and nanomaterials especially nanodiamond and discusses state of the art techniques such as combining dynamic and static compression to obtain monolithic materials

Dynamics of Heterogeneous Materials Vitali Nesterenko, 2013-03-09 This monograph deals with the behavior of essentially nonlinear heterogeneous materials in processes occurring under intense dynamic loading where microstructural effects play the main role This book is not an introduction to the dynamic behavior of materials and general information available in other books is not included The material herein is presented in a form I hope will make it useful not only for researchers working in related areas but also for graduate students I used it successfully to teach a course on the

dynamic behavior of materials at the University of California San Diego Another course well suited to the topic may be nonlinear wave dynamics in solids especially the part on strongly nonlinear waves About 100 problems presented in the book at the end of each chapter will help the reader to develop a deeper understanding of the subject I tried to follow a few rules in writing this book 1 To focus on strongly nonlinear phenomena where there is no small parameter with respect to the amplitude of disturbance including solitons shock waves and localized shear 2 To take into account phenomena sensitive to materials structure where typical space scale of material parameters particle size cell size are presented in the models or are variable in experimental research

High-Pressure Shock Compression of Solids VI Yasuyuki Horie, Lee Davison, Naresh Thadani, 2012-12-06 Both experimental and theoretical investigations make it clear that mesoscale materials that is materials at scales intermediate between atomic and bulk matter do not always behave in ways predicted by conventional theories of shock compression At these scales shock waves interact with local material properties and microstructure to produce a hierarchy of dissipative structures such as inelastic deformation fields randomly distributed lattice defects and residual stresses A macroscopically steady planar shock wave is neither plane nor steady at the mesoscale The chapters in this book examine the assumptions underlying our understanding of shock phenomena and present new measurements calculations and theories that challenge these assumptions They address such questions as What are the experimental data on mesoscale effects of shocks and what are the implications Can one formulate new mesoscale theories of shock dynamics How would new mesoscale theories affect our understanding of shock induced phase transitions or fracture What new computational models will be needed for investigating mesoscale shocks

Shock Waves in Materials Science Akira B. Sawaoka, 2012-12-06 In this volume the shock compression technology of materials is described in parallel with the latest research results and their background In the past this type of technology was developed in connection with military techniques by certain particular research organizations For this reason researchers of materials in general have had less opportunity to make use of the technology The conventional technology of shock compression has now been established and is recognized as being remarkably useful as a means of materials science study The feasibility of shock compression technology is dealt with in this book as well as the latest research results for general material scientists The shock synthesis of ceramics and intermetallic compounds as well as shock compression behavior are also described In contrast to conventional works of this kind this book describes shock compression studies performed by material scientists

High-Pressure Shock Compression of Solids IV Lee Davison, Y. Horie, Mohsen Shahinpoor, 2014-09-01

Overviews Of Recent Research On Energetic Materials Donald L. Thompson, Robert W Shaw, Thomas B Brill, 2005-08-02 Few books cover experimental and theoretical methods to characterize decomposition combustion and detonation of energetic materials This volume by internationally known and major contributors to the field is unique because it summarizes the most important recent work what we know with confidence and what main areas remain to be investigated Most chapters comprise summaries of work spanning decades and contain expert

commentary available nowhere else Although energetic materials are its focus this book provides a guide to modern methods for investigations of condensed and gas phase reactions Although these energetic reactions are complex and difficult to study the work discussed here provides readers with a substantial understanding of the behavior of materials now in use and a predictive capability for the development of new materials based on target properties

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

High-Pressure Shock Compression of Solids V Lee Davison, Yasuyuki Horie, Toshimori Sekine, 2012-12-06 Shock waves produce a wide variety of physical chemical mineralogical and other effects in materials through which they pass Since the beginning of civilization shock phenomena have been subjects of continuing interest speculation and enquiry The interdisciplinary aspects of investigations of shock phenomena are especially noteworthy and these investigations have been pursued by scientists and engineers from a broad range of disciplines Among the more novel and interesting investigations are those motivated by problems that arise in the Earth and planetary sciences Such events as meteorite impacts produce the obvious cratering effects seen on the planets and their satellites More subtle effects become apparent upon chemical and petrographic examination of the shock compressed solid material Shock waves are also prevalent in the larger universe and have played a prominent role in shaping the solar system as we know it The material in interstellar gas and dust clouds comets etc is processed by shock waves producing important chemical effects including formation of complex organic molecules The process of accretion of planets involves impacts of dust particles at relative velocities ranging from a fraction of a millimeter per second to impacts of larger bodies at velocities as great as several tens of kilometers per second The resulting shock waves cause both chemical and physical changes that are manifest in the bodies involved

My Journey with Shock Waves Yasuyuki Horie, 2022-08-24 This book compiles historical notes and a review of the work of the author and his associates on shock compression of condensed matter SCCM The work includes such topics as foundational aspects of SCCM thermodynamics thermodynamics of defects and plasticity as they relate to shock compression shock induced phase transition and shock compaction Also included are synthesis of refractory and hard ceramic compounds such as Ni aluminides SiC and diamonds method of characteristics discrete element methods the shock compression process at the grain scale and modeling shock to detonation transition in high explosives The book tells the story of how the author's view of shock physics came to be where it is now and analytically discusses how the author's appreciation of shock waves has evolved in time It offers a personal but pedagogical perspective on SCCM for young scientists and engineers who are starting their careers in the field For experts it offers materials to nudge them reflect on their own stories with the hope of planting a

seed of motivation to write them down to be published

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