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Shock-Wave Phenomena and the Properties of Condensed Matter



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Shock Wave Phenomena And The Properties Of Condensed Matter

Peter O. K. Krehl



Shock Wave Phenomena And The Properties Of Condensed Matter:

Shock-Wave Phenomena and the Properties of Condensed Matter Gennady I. Kanel, Sergey V. Razorenov, Vladimir E. Fortov, 2004-03-30 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 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 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 mechanical 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

Material Properties under Intensive Dynamic Loading Mikhail V. Zhernokletov, B. L. Glushak, 2007-07-16 Understanding the physical and thermomechanical response of materials subjected to intensive dynamic loading is a challenge of great significance in engineering today This volume assumes the task of gathering both experimental and diagnostic methods in one place since not much information has been previously disseminated in the scientific literature

Ultracondensed Matter by Dynamic Compression W. J. Nellis, 2017-05-15 This book clearly explains the processes of making ultracondensed matter using dynamic compression and provides an overview of research in this field

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

29th International Symposium on Shock Waves 1 Riccardo Bonazza, Devesh Ranjan, 2015-07-09 This proceedings present the results of the 29th International Symposium on Shock Waves ISSW29 which was held in Madison Wisconsin U S A from July 14 to July 19 2013 It was organized by the Wisconsin Shock Tube Laboratory which is part of the College of Engineering of the University of Wisconsin Madison The ISSW29 focused on the following areas Blast Waves Chemically Reactive Flows Detonation and Combustion Facilities Flow Visualization Hypersonic Flow Ignition Impact and Compaction Industrial Applications Magnetohydrodynamics Medical and Biological Applications Nozzle Flow Numerical Methods Plasmas Propulsion Richtmyer Meshkov Instability Shock Boundary Layer Interaction Shock Propagation and Reflection Shock Vortex Interaction Shock Waves in Condensed Matter Shock Waves in Multiphase Flow as well as Shock Waves in Rarefield Flow The two Volumes contain the papers presented at the symposium and serve as a reference for the participants of the ISSW 29 and individuals interested in these fields

Shock Waves in Solid State Physics G.I. Kanel', 2019-04-30 Methods and the latest results of experimental studies of the strength properties polymorphism and metastable states of materials and substances with extremely short durations of shock wave action are presented The author provides a comprehensive and theoretical description of specific features of the dynamics of elastoplastic shock compression waves in relaxing media The presentation is preceded by a detailed description of the theoretical foundations of the method and a brief discussion of the

basic methods of generating and diagnosing shock waves in solids Key Selling Features Addresses dynamic elastic plastic response spallation and shock induced phase transformation Provides a centralized presentation of topics of interest to the shock physics community Presents new data on the mechanism and basic patterns of sub microsecond polymorphic transformations and phase transitions Investigates destruction waves in shock compressed glasses Analyzes the behavior of highly hard brittle materials under shock wave loading and ways to diagnose fracture *Hydrodynamics of Explosion* Valery K. Kedrinskiy, 2005-11-04 Hydronamics of Explosion presents the research results for the problems of underwater explosions and contains a detailed analysis of the structure and the parameters of the wave fields generated by explosions of cord and spiral charges a description of the formation mechanisms for a wide range of cumulative flows at underwater explosions near the free surface and the relevant mathematical models Shock wave transformation in bubbly liquids shock wave amplification due to collision and focusing and the formation of bubble detonation waves in reactive bubbly liquids are studied in detail Particular emphasis is placed on the investigation of wave processes in cavitating liquids which incorporates the concepts of the strength of real liquids containing natural microinhomogeneities the relaxation of tensile stress and the cavitation fracture of a liquid as the inversion of its two phase state under impulsive explosive loading The problems are classed among essentially nonlinear processes that occur under shock loading of liquids and may be of interest to researchers in physical acoustics mechanics of multiphase media shock wave processes in condensed media explosive hydroacoustics and cumulation

Nanomechanics Alexander Vakhrushev, 2017-05-24 In recent years nanotechnology is the basis for the development of modern production This determined the urgency of the intensive development of the new direction of mechanics and nanomechanics for the scientific description of nanotechnological processes and the solution of several topical nanotechnology problems Topics included in the book cover a wide range of research in the field of nanomechanics thermomass theory of nanosystems deformation of nanomaterials interface mechanics of assembly carbon nanotube nanomechanics on surface molecular interactions and transformations nanomechanical sensors nanobeams and micromembranes nanostructural organic and inorganic materials green synthesis of metallic nanoparticles The main goal of these works is the establishment of the nanosystem macroparameter dependence on its nanoparameters using nanomechanics This book will be useful for engineers technologists and researchers interested in methods of nanomechanics and in advanced nanomaterials with complex behavior and their applications *Intense Shock Waves on Earth and in Space* Vladimir Fortov, 2021-05-26 This book focuses on the non traditional branches of physics and mechanics of shock waves that have arisen recently in connection with the intensive study of these waves in a wide variety of phenomena from nuclear matter to clusters of galaxies The book is devoted to the various physical phenomena and properties of intense shock waves The author addresses methods of generation diagnostics as well as theoretical methods for describing shock waves at extremely high pressures and temperatures in laboratory and quasi laboratory conditions The state of materials with high

energy density generated by shock wave compression is discussed. In addition, the book aims to systematize, generalize, and describe from a universal viewpoint the extensive theoretical and experimental material on the physics of high energy densities, the physics and mechanics of intense shock waves. The book is based on lectures delivered by the author at the Moscow Institute of Physics and Technology, the Higher School of Physics of Rosatom State Nuclear Energy Corporation, as well as overviews presented at many scientific conferences and symposia. It is useful to a wide range of researchers in natural sciences, giving them access to original works and allowing them to navigate the fascinating problems of the modern science of intense shock waves.

Extreme States of Matter Vladimir E. Fortov, 2015-12-26. With its many beautiful colour pictures, this book gives fascinating insights into the unusual forms and behaviour of matter under extremely high pressures and temperatures. These extreme states are generated among other things by strong shock, detonation and electric explosion waves, dense laser beams, electron and ion beams, hypersonic entry of spacecraft into dense atmospheres of planets, and in many other situations characterized by extremely high pressures and temperatures. Written by one of the world's foremost experts on the topic, this book will inform and fascinate all scientists dealing with materials properties and physics, and also serve as an excellent introduction to plasma shock wave and high energy density physics for students and newcomers seeking an overview. This second edition is thoroughly revised and expanded, in particular with new material on high energy density physics, nuclear explosions and other nuclear transformation processes.

30th International Symposium on Shock Waves 2 Gabi Ben-Dor, Oren Sadot, Ozer Igra, 2017-08-01. These proceedings collect the papers presented at the 30th International Symposium on Shock Waves (ISSW30) which was held in Tel Aviv, Israel, from July 19 to July 24, 2015. The Symposium was organized by Ortra Ltd. The ISSW30 focused on the state of knowledge of the following areas: Nozzle Flow, Supersonic and Hypersonic Flows with Shocks, Supersonic Jets, Chemical Kinetics, Chemical Reacting Flows, Detonation, Combustion, Ignition, Shock Wave Reflection and Interaction, Shock Wave Interaction with Obstacles, Shock Wave Interaction with Porous Media, Shock Wave Interaction with Granular Media, Shock Wave Interaction with Dusty Media, Plasma Magnetohydrodynamics, Re-entry to Earth Atmosphere, Shock Waves in Rarefied Gases, Shock Waves in Condensed Matter, Solids and Liquids, Shock Waves in Dense Gases, Shock Wave Focusing, Richtmyer-Meshkov Instability, Shock Boundary Layer Interaction, Multiphase Flow, Blast Waves, Facilities, Flow Visualization and Numerical Methods. The two volumes serve as a reference for the participants of the ISSW30 and anyone interested in these fields.

High-Energy-Density Physics R. Paul Drake, 2006-08-31. This book has two goals. One goal is to provide a means for those new to high energy density physics to gain a broad foundation from one text. The second goal is to provide a useful working reference for those in the field. This book has at least four possible applications in an academic context. It can be used for training in high energy density physics in support of the growing number of university and laboratory research groups working in this area. It also can be used by schools with an emphasis on ultrafast lasers to provide some introduction to issues present in all laser target

periments with high power lasers and with thorough coverage of the material in Chap 11 on relativistic systems. In addition, it could be used by physics, applied physics, or engineering departments to provide in a single course an introduction to the basics of fluid mechanics and radiative transfer with dynamic applications. Finally, it could be used by astrophysics departments for a similar purpose with the benefit of training the students in the similarities and differences between laboratory and astrophysical systems. The notation in this text is deliberately sparse and, when possible, a given symbol has only one meaning. A definition of the symbols used is given in Appendix A. In various cases, additional subscripts are added to distinguish among cases of the same quantity, as for example in the use of ρ_1 and ρ_2 to distinguish the mass density in two different regions.

Dynamic Behavior of Materials Mikko Hokka, 2023-11-21. *Dynamic Behavior of Materials: Fundamentals, Material Models, and Microstructure Effects* provides readers with the essential knowledge and tools necessary to determine best practice design, modeling, simulation, and application strategies for a variety of materials while also covering the fundamentals of how material properties and behavior are affected by material structure and high strain rates. The book examines the relationships between material microstructure and consequent mechanical properties, enabling the development of materials with improved performance and more effective design of parts and components for high rate applications. Sections cover the fundamentals of dynamic material behavior with chapters studying dynamic elasticity and wave propagation, dynamic plasticity of crystalline materials, ductile fracture, brittle fracture, adiabatic heating, and strain localization, response to shock loading, various material characterization methods such as the Hopkinson Bar Technique, the Taylor Impact Experiment, different shock loading experiments, recent advances in dynamic material behavior, the dynamic behaviors of nanocrystalline materials, bulk metallic glasses, additively manufactured materials, ceramics, concrete, and concrete reinforced materials, geomaterials, polymers, composites, and biomaterials, and much more. Focuses on the relationship between material microstructure and resulting mechanical responses. Covers the fundamentals, characterization methods, modeling techniques, applications, and recent advances of the dynamic behavior of a broad array of materials. Includes insights into manufacturing and processing techniques that enable more effective material design and application. Dynamic Behavior of Materials, Volume 1

Tom Proulx, 2011-03-31. *Dynamic Behavior of Materials: Volume 1*. Proceedings of the 2010 Annual Conference on Experimental and Applied Mechanics, the first volume of six from the Conference, brings together 71 contributions to this important area of research and engineering. The collection presents early findings and case studies on fundamental and applied aspects of Materials Science, including papers on Composite Materials, Dynamic Failure and Fracture, Dynamic Materials Response, Novel Testing Techniques, Low Impedance Materials, Metallic Materials Response of Brittle Materials, Time Dependent Materials, High Strain Rate Testing of Biological and Soft Materials, Shock and High Pressure Response, Energetic Materials, Optical Techniques for Imaging High Strain Rate Material Response, and Modeling of Dynamic Response.

Intense Dynamic Loading Of Condensed Matter A. V. Bushman, 1992-12-01. This book reviews the science and technology

necessary to understand predict and simulate the phenomena associated with intense dynamic loading of matter The book begins with background information on shock wave phenomena in materials and how they are measured This includes materials with strength materials undergoing dynamic phase transformations and material fracturing The authors then cover the phenomena associated with detonations where the chemical energy release of an explosive is an integral part of the hydrodynamics and describe the formation and application of the semi empirical equation of state They develop the numerical techniques for doing realistic computer simulations of complicated dynamical processes associated with impacts The book closes with reviews simulations compared with experiments for a variety of dynamic loading events including laser and electron beam interactions with metals high explosive loading of iron and impacts of cometary dust on the Vega space probe as it crossed the tail of Hailey s comet

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

Adiabatic Shear Localization Bradley Dodd,Yilong Bai,2012-05-22 Adiabatic shear localization is a mode of failure that occurs in dynamic loading It is characterized by thermal softening occurring over a very narrow region of a material and is usually a precursor to ductile fracture and catastrophic failure This reference source is the revised and updated version of the first detailed study of the mechanics and modes of adiabatic shear localization in solids Building on the success of the first edition the book provides a systematic description of a number of aspects of adiabatic shear banding The concepts and techniques described in this work can usefully be applied to solve a multitude of problems encountered by those investigating fracture and damage in materials impact dynamics metal working and other areas Specific chapters focus on energetic materials polymers bulk metal glasses and the mathematics of shear banding as well as the numerical modeling of them With

its detailed coverage of the subject this book is of great interest to academics and researchers into materials performance as well as professionals Up to date coverage of the subject and research that has occurred over the past 20 years Each chapter is written on a different sub field of adiabatic shear by an acknowledged expert in the field Detailed and clear discussions of each aspect An Introduction to High-Pressure Science and Technology Jose Manuel Recio,Jose Manuel Menendez,Alberto Otero de la Roza,2016-01-05 An Introduction to High Pressure Science and Technology provides you with an understanding of the connections between the different areas involved in the multidisciplinary science of high pressure The book reflects the deep interdisciplinary nature of the field and its close relationship with industrial applications Thirty nine specialists in high

Whispering the Secrets of Language: An Mental Quest through **Shock Wave Phenomena And The Properties Of Condensed Matter**

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