

MODELING THE DEFORMATION OF CRYSTALLINE SOLIDS



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Modeling The Deformation Of Crystalline Solids

J. Gittus, J. Zarka



Modeling The Deformation Of Crystalline Solids:

A Framework for Multiscale Modeling of Deformation in Crystalline Solids, 2006 A simulation framework was developed for studying the deformation behavior of metallic materials Atomistic simulations were employed to study dislocation nucleation during nanoindentation and to correlate dislocation behavior and overall material response in thin film crystals An instrumented indenter was acquired to study the indentation behavior of metallic composites Experimental and continuum based modeling works on indentation of discontinuously reinforced metal matrix composites were also conducted Detailed microscopic features were analyzed which aided in our fundamental understanding of plastic deformation in these materials *Modeling the Deformation of Crystalline Solids*, 1991 Modeling the Deformation of Crystalline Solids Terry C. Lowe, 1991-01-01 Proceedings of a symposium held at the annual TMS meeting New Orleans Louisiana February 1991 The first papers contain theories and supporting experimentation for deformation and microstructure evolution The remainder concentrate on applications and experimental verification and are grouped into 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 *Handbook of Materials Modeling* Sidney Yip, 2007-11-17 This Handbook contains a set of articles introducing the modeling and simulation of materials from the standpoint of basic methods and studies The intent is to provide a compendium that is foundational to an emerging field of computational research a new discipline that may now be called Computational Materials This area has become sufficiently diverse that any attempt to cover all the pertinent topics would be futile Even with a limited scope the present undertaking has required the dedicated efforts of 13 Subject Editors to set the scope of nine chapters solicit authors and collect the manuscripts The contributors were asked to target students and non specialists as the primary audience to provide an accessible entry into the field and to offer references for further reading With no precedents to follow the editors and authors were only guided by a common goal to produce a volume that would set a standard toward defining the broad community and stimulating its growth The idea of a reference work on materials modeling surfaced in conversations with

Peter Bin eld then the Reference Works Editor at Kluwer Academic Publishers in the spring of 1999 The rationale at the time already seemed quite clear the eld of computational materials research was t ing off powerful computer capabilities were becoming increasingly available and many sectors of the scienti c community were getting involved in the enterprise

NASA Technical Memorandum ,1994 Programming Phase-Field Modeling S. Bulent Biner,2017-01-25 This textbook provides a fast track pathway to numerical implementation of phase field modeling a relatively new paradigm that has become the method of choice for modeling and simulation of microstructure evolution in materials It serves as a cookbook for the phase field method by presenting a collection of codes that act as foundations and templates for developing other models with more complexity Programming Phase Field Modeling uses the Matlab Octave programming package simpler and more compact than other high level programming languages providing ease of use to the widest audience Particular attention is devoted to the computational efficiency and clarity during development of the codes which allows the reader to easily make the connection between the mathematical formulism and the numerical implementation of phase field models The background materials provided in each case study also provide a forum for undergraduate level modeling simulations courses as part of their curriculum

Mathematical Modeling of Dislocation Behavior and Its Application to Crystal Plasticity Analysis Tetsuya Ohashi,2023-07-31 There are several textbooks and monographs on dislocations and the mechanical and physical properties of metals but most of them discuss the topics in terms of more or less one dimensional or scalar quantities However actual metallic materials are often three dimensionally heterogeneous in their microstructure and this heterogeneity has a significant impact on the macroscopic mechanical properties With advances in computational technology the complexity introduced by spatial heterogeneity in the microstructure of metals can now be explored using numerical methods This book explains in simple terms the idea of extending the continuum mechanics theory of plastic deformation of crystals to three dimensional analysis and applying it to the analysis of more realistic models of metal microstructures This book links solid mechanics and materials science by providing clear physical pictures and mathematical models of plastic slip deformation and the accumulation of dislocations and atomic vacancies in metallic materials Both monotonic and cyclic loading cases are considered

Multiscale Modeling in Continuum Mechanics and Structured Deformations Gianpetro Del Piero,David R. Owen,2014-05-04 The purpose of the book is to present some recent progress in two active and related areas of continuum mechanics fracture mechanics and structured deformations The book may be divided into two parts The first part deals with the theory of structured deformations a basic concept that can be used to describe smooth and nonsmooth geometrical changes at different length scales including for example both slip and microslip and of particular interest in the second part of this course both macroscopic fracture and microfracture The work presents an updated account of the state of the art in the subject

Computational Methods for Microstructure-Property Relationships Somnath Ghosh,Dennis Dimiduk,2010-11-17 Computational Methods for

Microstructure Property Relationships introduces state of the art advances in computational modeling approaches for materials structure property relations Written with an approach that recognizes the necessity of the engineering computational mechanics framework this volume provides balanced treatment of heterogeneous materials structures within the microstructural and component scales Encompassing both computational mechanics and computational materials science disciplines this volume offers an analysis of the current techniques and selected topics important to industry researchers such as deformation creep and fatigue of primarily metallic materials Researchers engineers and professionals involved with predicting performance and failure of materials will find Computational Methods for Microstructure Property Relationships a valuable reference

Foundations of Elastoplasticity: Subloading Surface Model Koichi Hashiguchi, 2023-06-12 This book is the standard text book for elastoplasticity viscoplasticity which is explained comprehensively covering the rate independent to dependent finite deformations of metals soils polymers crystal plasticity etc and the friction phenomenon Concise explanations on vector tensor analysis and continuum mechanics are provided first covering the underlying physical concepts e g various time derivatives pull back and push forward operations work conjugacy and multiplicative decomposition of deformation gradient tensor Then the rigorous elastoplastic viscoplastic model called the subloading surface model is explained comprehensively which is based on the subloading surface concept to describe the continuous development of the plastic viscoplastic strain rate as the stress approaches to the yield surface while it can never be described by the other plasticity models e g the Chaboche Ohno and the Dafalias Yoshida models assuming the purely elastic domain The main features of the subloading surface model are as follows 1 The subloading surface concept underlying the cyclic plasticity is introduced which insists that the plastic deformation develops as the stress approaches the yield surface Thus the smooth elastic plastic transition leading to the continuous variation of the tangent stiffness modulus is described always 2 The subloading overstress model is formulated by which the elastoplastic deformation during the quasi static loading and the viscoplastic deformation during the dynamic and impact loading can be described by the unified equation Then only this model can be used to describe the deformation in the general rate of deformation disusing the elastoplastic constitutive equation 3 The hyperelastic based visco plasticity based on the multiplicative decomposition of deformation gradient tensor and the subloading surface model is formulated for the exact descriptions of the finite elastic and visco plastic deformations 4 The subloading friction model is formulated for the exact description of the dry and the fluid lubricated frictions at the general rate of sliding from the static to the impact sliding Thus all the elastic and inelastic deformation sliding phenomena of solids can be described accurately in the unified equation by the subloading overstress model The subloading surface model will be engraved as the governing law of irreversible deformation of solids in the history of solid mechanics

Mathematical Modeling of Shock-Wave Processes in Condensed Matter Tatiana Aleksandrovna Khantuleva, 2022-07-18 This book offers an interdisciplinary theoretical approach based on non equilibrium statistical

thermodynamics and control theory for mathematically modeling shock induced out of equilibrium processes in condensed matter The book comprises two parts The first half of the book establishes the theoretical approach reviewing fundamentals of non equilibrium statistical thermodynamics and control theory of adaptive systems The latter half applies the presented approach to a problem on shock induced plane wave propagation in condensed matter The result successfully reproduces the observed feature of waveform propagation in experiments which conventional continuous mechanics cannot access Further the consequent stress strain relationships derived with relaxation and inertia effect in elastic plastic transition determines material properties in transient regimes

Micro and Nanomachining Technology-Size, Model and Complex

Mechanism Xuesong Han,2014-01-27 Recent advances in science and technology such as online monitoring techniques coupling of various processing methods surface characterization and measurement techniques have greatly promoted the development of ultraprecise machining technology This precision now falls into the micrometer and nanometer range hence the name micro nanomachining technology MNT Machining is a complex phenomenon associated with a variety of different mechanical physical and chemical processes Common principles defining control mechanisms such as O Jamie de geometry Newton mechanics Macroscopic Thermodynamics and Electromagnetics are not applicable to phenomena occurring at the nanometer scale whereas quantum effects wave characteristics and the microscopic fluctuation become the dominant factors A remarkable enhancement in computational capability through advanced computer hardware and high performance computation techniques parallel computation has enabled researchers to employ large scale parallel numerical simulations to investigate micro nanomachining technologies and gain insights into related processes Micro and Nanomachining Technology Size Model and Complex Mechanism introduces readers to the basics of micro nanomachining MNT technology and covers some of the above techniques including molecular dynamics and finite element simulations as well as complexity property and multiscale MNT methods This book meets the growing need of Masters students or Ph D students studying nanotechnology mechanical engineering or materials engineering allowing them to understand the design and process issues associated with precision machine tools and the fabrication of precision components

Superalloys 2024

Jonathan Cormier,Ian Edmonds,Stephane Forsik,Paraskevas Kontis,Corey O'Connell,Timothy Smith,Akane Suzuki,Sammy Tin,Jian Zhang,2024-08-20 The 15th International Symposium on Superalloys Superalloys 2024 highlights technologies for lifecycle improvement of superalloys In addition to the traditional focus areas of alloy development processing mechanical behavior coatings and environmental effects this volume includes contributions from academia supply chain and product user members of the superalloy community that highlight technologies that contribute to improving manufacturability affordability life prediction and performance of superalloys

Dislocation Mechanism-Based Crystal Plasticity

Zhuo Zhuang,Zhanli Liu,Yinan Cui,2019-04-12 Dislocation Based Crystal Plasticity Theory and Computation at Micron and Submicron Scale provides a comprehensive introduction to the continuum and discreteness dislocation mechanism based theories and

computational methods of crystal plasticity at the micron and submicron scale Sections cover the fundamental concept of conventional crystal plasticity theory at the macro scale without size effect strain gradient crystal plasticity theory based on Taylor law dislocation mechanism at the mesoscale phase field theory of crystal plasticity computation at the submicron scale including single crystal plasticity theory and the discrete continuous model of crystal plasticity with three dimensional discrete dislocation dynamics coupling finite element method DDD FEM Three kinds of plastic deformation mechanisms for submicron pillars are systematically presented Further sections discuss dislocation nucleation and starvation at high strain rate and temperature effect for dislocation annihilation mechanism Covers dislocation mechanism based crystal plasticity theory and computation at the micron and submicron scale Presents crystal plasticity theory without size effect Deals with the 3D discrete continuous 3D DCM theoretic and computational model of crystal plasticity with 3D discrete dislocation dynamics 3D DDD coupling finite element method FEM Includes discrete dislocation mechanism based theory and computation at the submicron scale with single arm source coating micropillar lower cyclic loading pillars and dislocation starvation at the submicron scale

Crystals, Defects and Microstructures Rob Phillips, 2001-02-22 Materials science has emerged as one of the central pillars of the modern physical sciences and engineering and is now even beginning to claim a role in the biological sciences A central tenet in the analysis of materials is the structure property paradigm which proposes a direct connection between the geometric structures within a material and its properties The increasing power of high speed computation has had a major impact on theoretical materials science and has permitted the systematic examination of this connection between structure and properties

Constitutive Modelling of Solid Continua José Merodio, Raymond Ogden, 2019-11-14 This volume consists of a collection of chapters by recognized experts to provide a comprehensive fundamental theoretical continuum treatment of constitutive laws used for modelling the mechanical and coupled field properties of various types of solid materials It covers the main types of solid material behaviour including isotropic and anisotropic nonlinear elasticity implicit theories viscoelasticity plasticity electro and magneto mechanical interactions growth damage thermomechanics poroelasticity composites and homogenization The volume provides a general framework for research in a wide range of applications involving the deformation of solid materials It will be of considerable benefit to both established and early career researchers concerned with fundamental theory in solid mechanics and its applications by collecting diverse material in a single volume The readership ranges from beginning graduate students to senior researchers in academia and industry

Simulation of Material Processing: Theory, Methods and Application Ken-ichiro Mori, 2001-01-01 This volume contains about 180 papers including seven keynotes presented at the 7th NUMIFORM Conference It reflects the state of the art of simulation of industrial forming processes such as rolling forging sheet metal forming injection moulding and casting

Magnesium Technology 2017 Kiran N. Solanki, Dmytro Orlov, Alok Singh, Neale R. Neelameggham, 2017-02-14 The Magnesium Technology Symposium the event on which this collection is

based is one of the largest yearly gatherings of magnesium specialists in the world. Papers represent all aspects of the field ranging from primary production to applications to recycling. Moreover, papers explore everything from basic research findings to industrialization. Magnesium Technology 2017 covers a broad spectrum of current topics including alloys and their properties, cast products and processing, wrought products and processing, forming, joining and machining, corrosion and surface finishing, ecology and structural applications. In addition, there is coverage of new and emerging applications.

Multiscale Modeling of Heterogeneous Materials Oana Cazacu, 2013-03-01. A material's various properties are based on its microscopic and nanoscale structures. This book provides an overview of recent advances in computational methods for linking phenomena in systems that span large ranges of time and spatial scales. Particular attention is given to predicting macroscopic properties based on subscale behaviors. Given the book's extensive coverage of multi-scale methods for modeling both metallic and geologic materials, it will be an invaluable reading for graduate students, scientists, and practitioners alike.

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