Shape Memory Alloys

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Actuator Design Using Shape Memory Alloys - Tom Waram 1993-01-01

Shape Memory Alloys - M. Fremond 1996-06-04
This book consists of two chapters. The first chapter deals with the thermomechanical macroscopic theory describing the transformation and deformation behavior of shape memory alloys. The second chapter deals with the extensive and fundamental review of the experimental works which include crystallography, transformations and mechanical characteristics in Ti-Ni, Cu-base and ferrous shape memory alloys.
Shape Memory Materials - K. Otsuka 1999-10-07
A comprehensive account of shape memory materials, now available in paperback.
Shape Memory and Superelastic Alloys: Applications and Technologies - Kiyoshi Yamauchi 2011-05
Shape memory and superelastic alloys possess properties not present in ordinary metals meaning that they can be used for a variety of applications. Shape memory and superelastic alloys: Applications and technologies explores these applications discussing their key features and commercial performance. Readers will gain invaluable information and insight into the current and potential future applications of shape memory alloys. Part one covers the properties and processing of shape memory effect and superelasticity in alloys for practical users with chapters covering the basic characteristics of Ti-Ni-based and Ti-Nb-based shape memory and superelastic (SM/SE) alloys, the development and commercialisation of TiNi and Cu-based alloys, industrial processing and device elements, design of SMA coil springs for actuators before a final overview on the development of SM and SE applications. Part two introduces SMA application technologies with chapters investigating SMAs in electrical applications, hot-water supply, construction and housing, automobiles and railways and aerospace engineering before looking at the properties, processing and applications of Ferrous (Fe)-based SMAs. Part three focuses on the applications of superelastic alloys and explores their functions in the medical, telecommunications, clothing, sports and leisure industries. The appendix briefly describes the history and activity of the Association of Shape Memory Alloys (ASMA). With its distinguished editors and team of expert contributors, Shape memory and superelastic alloys: Applications and technologies is be a valuable reference tool for metallurgists as well as for designers, engineers and students involved in one of the many industries in which shape memory effect and superelasticity are used such as construction, automotive, medical, aerospace, telecommunications, water/heating, clothing, sports and leisure. Explores important applications of shape memory and superelastic alloys discussing their key features and commercial performanceAssesses the properties and processing of shape memory effect and superelasticity in alloys for practical users with chapters covering the basic characteristicsIntroduces SMA application technologies investigating SMAs in electrical applications, hot-water supply, construction and housing, automobiles and railways and aerospace engineering

Shape Memory Alloy' 86 - Youyi Chu 1986

Engineering Aspects of Shape Memory Alloys - T. W. Duerig 1990-01-01
This book consists of five parts. Part 1 deals with the mechanism of shape memory and the alloys that exhibit the effect; Part 2 deals primarily with constrained recovery but to some extent with free recovery; Part 3 and 4 deal with actuators with part 3 introducing engineering principles and part 4 several specific examples; Part 5 deals with superelasticity.
Theoretical and Numerical Modeling of Shape Memory Alloys - Garrett Joseph Hall 2001

Aeroelastic Characteristics of Wing with Embedded Shape Memory Alloys - Morteza Dardel 2012
Shape memory alloys have the ability to change the structural and aeroelastic characteristics of wings greatly. They can produce high axial forces due to temperature changes. Temperature changes lead to transition between different phases of the shape memory alloy, which widely alter their mechanical properties. They recover their original shape with changing the temperature. Embedding shape memory wires into wings can greatly increase the flutter margin, while impose a minor weight on the system. Also, the amplitude of the limit cycle oscillations that cause fatigue of the wing will be reduced.
Shape-Memory Alloys Handbook - Christian Lexcellent 2013-04-08
The aim of this book is to understand and describe themartensitic phase transformation and the process of martensiteplatelet reorientation. These two key elements enable the author tointroduce the main features associated with the behavior ofshape-memory alloys (SMAs), i.e. the one-way shape-memory effect,pseudo-elasticity, training and recovery. Attention is paid in particular to the thermodynamical frame forsolid materials modeling at the macroscopic scale and itsapplications, as well as to the particular use of such alloys– the simplified calculations for the bending of bars andtheir torsion. Other chapters are devoted to key topics such as theuse of the "crystallographical theory of martensite"for SMA modeling, phenomenological and statistical investigationsof SMAs, magneto-thermo-mechanical behavior of magnetic SMAs andthe fracture mechanics of SMAs. Case studies are provided on thedimensioning of SMA elements offering the reader an additionaluseful framework on the subject. Contents 1. Some General Points about SMAs. 2. The World of Shape-memory Alloys. 3. Martensitic Transformation. 4. Thermodynamic Framework for the Modeling of SolidMaterials. 5. Use of the "CTM" to Model SMAs. 6. Phenomenological and Statistical Approaches for SMAs. 7. Macroscopic Models with Internal Variables. 8. Design of SMA Elements: Case Studies. 9. Behavior of Magnetic SMAs. 10. Fracture Mechanics of SMAs. 11. General Conclusion. Appendix 1. Intrinsic Properties of Rotation Matrices. Appendix 2. "Twinning Equation" Demonstration. Appendix 3. Calculation of the Parameters a, n and Q from the"Twinning" Equation. Appendix 4. "Twinned" Austenite/MartensiteEquation. About the Authors Christian Lexcellent is Emeritus Professor at the ÉcoleNational Supérieure de Mécanique et des Microtechniquesde Besançon and a researcher in the Department of AppliedMechanics at FEMTO-ST in France. He is a specialist in themechanics of materials and phase transition and has taught in thesubjects of mechanics of continuum media and shape memory alloys.He is also a member of the International Committee of ESOMAT.
Progress in Shape Memory Alloys - Stephan Eucken 1992-01-01

Phase Transitions of Shape Memory Alloys in Soft and Hard Loading Devices - Michael Schwarz 1996

Shape Memory Alloys for Seismic Resilience - Cheng Fang 2019-05-25
This book introduces readers to the fundamental properties and practical applications of shape memory alloys (SMAs) from the perspective of seismic engineering. It objectively discusses the superiority of this novel class of materials, which could potentially overcome the limitations of conventional seismic control technologies. The results, vividly presented in the form of tables and figures, are demonstrated with rigorous experimental verifications, supplemented by

comprehensive numerical and analytical investigations. The book allows readers to gain an in-depth understanding of the working mechanisms of various SMA-based structural devices and members, including beam-to-column connections, dampers, and braces, while also providing them with a broader vision of next-generation, performance-based seismic design for novel adaptive structural systems. Helping to bridge the gap between material science and structural engineering, it also sheds light on the potential of commercializing SMA products in the construction industry. The cutting-edge research highlighted here provides technical incentives for design professionals, contractors, and building officials to use high-performance and smart materials in structural design, helping them stay at the forefront of construction technology.

Theoretical Investigation in the Shape Memory Alloy (SMA) - Zina Al shadidi 2015-06-03

Shape Memory Alloys - H. R. Chen 2010

A shape memory alloy (SMA, also known as a smart metal, memory alloy, or muscle wire) is an alloy that "remembers" its shape, and can be returned to that shape after being deformed, by applying heat to the alloy. When the shape memory effect is correctly harnessed, this material becomes a lightweight, solid-state alternative to conventional actuators such as hydraulic, pneumatic, and motor-based systems. Shape memory alloys have numerous applications in the medical and aerospace industries. This book presents the latest research in the field from around the globe.

Thin Film Shape Memory Alloys - Shuichi Miyazaki 2009-09-03

The first dedicated book describing the properties, preparation, characterization and device applications of TiNi-based shape memory alloys.

Multi-dimensional Behaviour of Shape Memory Alloys - Yongfa Zhang 1999

Shape Memory Alloys - Natalia Resnina 2015

The collective monograph consists of five parts: Theory and modeling ofmartensitic transformation and functional properties; Martensitictransformations and shape memory effects; Controlling the functionalproperties of shape memory alloys; Shape memory alloys with complexstructure; Application of shape memory alloys) covering of all aspects ofshape memory alloys from theory and modelling to applications. It presentsthe scientific results obtained by leading scientific teams studying shapememory alloys in the former Soviet Republics together with their colleaguesfrom other countries during the last decade.

Shape Memory Alloys - Funakubo 1987-07-14

Phase-field Modeling of Multi-domain Evolution in Ferromagnetic Shape Memory Alloys and of Polycrystalline Thin Film Growth - Christian Mennerich 2014-05-13

The phase-field method is a powerful tool in computer-aided materials science as it allows for the analysis of the time-spatial evolution of microstructures on the mesoscale. A multi-phase-field model is adopted to run numerical simulations in two different areas of scientific interest: Polycrystalline thin films growth and the ferromagnetic shape memory effect. FFT-techniques, norm conservative integration and RVE-methods are necessary to make the coupled problems numerically feasible.

Control Problems with State Constraints for Shape Memory Alloys - Jan Sokołowski 1992

Shape Memory Alloys - Dimitris C. Lagoudas 2010-02-12

This book provides a working knowledge of the modeling and engineering applications of shape memory alloys (SMAs), beginning with a rigorous introduction to continuum mechanics and continuum thermodynamics as they relate to the development of SMA modeling.Modern SMAs can recover from large amounts of bending and deformation, and millions of repetitions within recoverable ranges. SMAs are used in the medical industry to create stents, in the dental industry to create dental and orthodontic archwires, and in the aerospace industry to create fluid fittings. The text presents a unified approach to the constitutive modeling of SMAs, including modeling of magnetic and high temperature SMAs.

Phase transitions in shape memory alloys - Karl-Heinz Hoffmann 1987

Shape-memory Alloys - Ferdinando Auricchio

1995

On the dynamics of structural phase transitions in shape memory alloys - Marek Niezgódka 1986

Ferromagnetic Shape Memory Alloys II - V. A. Chernenko 2010
This work on Ferromagnetic Shape Memory Alloys contains selected peer-reviewed papers. Such materials belong to the most exciting and fastest-growing group of martensitic multifunctional materials. The selected papers cover the following topics of: Basic phenomena and theory; Structure and magnetic properties; Magnetomechanics and magnetocaloric effect; Thin films and composites; Modeling and simulations and Processing and engineering. This volume will be useful to anyone who is already working with novel advanced materials, as well as to those seeking an accessible introduction to the relatively new field of FSMAs.
Ni-free Ti-based Shape Memory Alloys - Hee Young Kim 2018-09-17
Ni-free Ti-based Shape Memory Alloys reviews the fundamental issues of biomedical beta-type Ti base shape memory and superelastic alloys, including martensitic transformation, shape memory and superelastic properties, alloy development, thermomechanical treatment and microstructure control, and biocompatibility. Some unique properties, such as large nonlinear elastic behavior and low Young's modulus, observed in metastable Ti alloys are discussed on the basis of phase stability. As it is expected that superelastic Ti alloys will further expand the applications of shape memory alloys within the biomedical field, this book provides a comprehensive review of these new findings in Ti-base shape memory and superelastic alloys. Includes coverage of phase transformations in titanium alloys Discusses mechanical properties and alloy development Presents a review of Ti-based shape alloys and their applications
Shape Memory Materials - Arun D I 2018-04-27
This work addresses the basic principles, synthesis / fabrication and applications of smart materials, specifically shape memory materials Based on origin, the mechanisms of transformations vary in different shape memory materials and are discussed in different chapters under titles of shape memory alloys, ceramics, gels and polymers Complete coverage of composite formation with polymer matrix and reinforcement filler conductive materials with examples
Pseudoelasticity of Shape Memory Alloys - Andrzej Ziolkowski 2015-03-20
Pseudoelasticity of Shape Memory Alloys: Theory and Experimental Studies is devoted to the phenomenon of pseudoelasticity (superelasticity) exhibited by shape memory alloy materials. It provides extensive introductory content on the state-of-the-art in the field, including SMA materials development, definition of shape memory effects, and discussions on where shape memory behavior is found in various engineering application areas. The book features a survey of modeling approaches targeted at reliable prediction of SMA materials' behavior on different scales of observation, including atomistic, microscopic, mezoscopic, and macroscopic. Researchers and graduate students will find detailed information on the modern methodologies used in the process of building constitutive models of advanced materials exhibiting complex behavior. Introduces the phenomenon of pseudoelasticity exhibited by shape memory alloy materials Features a survey of modeling approaches targeted at reliable prediction of SMN materials' behavior on different scales of observation Provides extensive coverage of the state-of-the-art in the field Ideal reference for researchers and graduate students interested in the modern methodologies used in the process of building constitutive models of advanced materials
Nickel Free Titanium Based Shape Memory Alloys - Syed Kamil 2010-11
Biomedical shape memory alloys are required to have a superior corrosion resistance, biocompatibility and stable shape memory properties. Among many shape memory alloys, only NiTi alloys have been widely applied for biomedical applications, because they satisfy the above requirements. However, it has been pointed out that pure nickel is a toxic element and cause nickel hypersensitivity. It is preferable to develop absolutely safe nickel free titanium based shape memory alloys composed of non-toxic elements such as niobium for biomedical

applications. In this book, the effect of molybdenum addition in Ti-Nb binary alloy was investigated. Two alloys with varying compositions namely alloy 1 (Ti-26at%Nb) and alloy 2 (Ti-26at%Nb-0.1at%Mo) were developed. After homogenization and cold rolling, samples of dimensions 30×3×0.86 mm were prepared using diamond cutting machine. The prepared samples were solution treated and then subjected to different tests to evaluate their properties. There is slight increase in micro-hardness (Hv) with increase in molybdenum. XRD spectra revealed the presence of two phases in the solution treated samples, -martensite (Ti4Nb) and retained austenite ( ).

Fabrication and Processing of Shape Memory Alloys - Kush Mehta 2018-09-01

This book showcases different processes of fabrication and processing applied to shape memory alloys. It provides details and collective information on working principles, process mechanisms, salient features, novel aspects, process capabilities, properties of material and unique applications of shape memory alloys. The recent progress on fabrication and processing are specially addressed in this book. It covers major topics of manufacturing such as machining, joining, welding and processing of shape memory alloys.

Advances in Shape Memory Materials - V. A. Chernenko 2008

This specialist book, the first of its kind, includes original and review articles which describe magnetic shape-memory alloys and the magnetic shape-memory effect. These topics are currently the object of world-wide research and development. In particular, the authors in the present book concentrated upon describing the phenomenological and microscopic mechanisms of the magnetic shape-memory effect, on the physical basis of the advanced properties of magnetic shape-memory alloys and on the structural aspects of martensitic transformations in both ferromagnetic and non-ferromagnetic shape-memory alloys. Several chapters are devoted to more general issues such as damping, the newly-discovered glassy martensite and modeling. The reader will also find copious information on technical applications and actuators which utilize shape-memory alloys with due consideration given to the relevant design principles and the analysis of simulation results. This book will therefore be of great interest to anyone working on the research or development aspects of smart materials.

Magnetic Shape Memory Alloys - Xuexi Zhang 2021-11-14

This book systematically describes the fundamentals of Magnetic shape memory alloys (MSMAs), with an emphasis on low-dimensional structures such as foams, microwires and micro-particles. The respective chapters address basic concepts and theories, the fabrication of various architectures, microstructure tailoring, property optimization and cutting-edge applications. Taken together, they provide a clear understanding of the correlation between processing and the microstructural properties of MSMAs, which are illustrated in over two hundred figures and schematics. Given its scope and format, the book offers a valuable resource for a broad readership in various fields of materials science and engineering, especially for researchers, students and engineers.

Shape Memory Alloys - Farzad Ebrahimi 2017-09-20

This book is a result of contributions of experts from international scientific community working in different aspects of shape memory alloys (SMAs) and reports on the state-of-the-art research and development findings on this topic through original and innovative research studies. Through its five chapters, the reader will have access to works related to ferromagnetic SMAs, while it introduces some specific applications like development of faster SMA actuators and application of nanostructural SMAs in medical devices. The book contains up-to-date publications of leading experts, and the edition is intended to furnish valuable recent information to the professionals involved in shape memory alloys analysis and applications. The text is addressed not only to researchers but also to professional engineers, students, and other experts in a variety of disciplines, both academic and industrial, seeking to gain a better understanding of what has been done in the field recently and what kind of open problems are in this area.

Shape Memory Alloy Actuators - Mohammad H. Elahinia 2016-01-19

This book provides a systematic approach to

realizing NiTi shape memory alloy actuation, and is aimed at science and engineering students who would like to develop a better understanding of the behaviors of SMAs, and learn to design, simulate, control, and fabricate these actuators in a systematic approach. Several innovative biomedical applications of SMAs are discussed. These include orthopedic, rehabilitation, assistive, cardiovascular, and surgery devices and tools. To this end unique actuation mechanisms are discussed. These include antagonistic bi-stable shape memory-superelastic actuation, shape memory spring actuation, and multi axial tension-torsion actuation. These actuation mechanisms open new possibilities for creating adaptive structures and biomedical devices by using SMAs.

First Principles Modelling of Shape Memory Alloys - Oliver Kastner 2012-08-01

Materials sciences relate the macroscopic properties of materials to their microscopic structure and postulate the need for holistic multiscale research. The investigation of shape memory alloys is a prime example in this regard. This particular class of materials exhibits strong coupling of temperature, strain and stress, determined by solid state phase transformations of their metallic lattices. The present book presents a collection of simulation studies of this behaviour. Employing conceptually simple but comprehensive models, the fundamental material properties of shape memory alloys are qualitatively explained from first principles. Using contemporary methods of molecular dynamics simulation experiments, it is shown how microscale dynamics may produce characteristic macroscopic material properties. The work is rooted in the materials sciences of shape memory alloys and covers thermodynamical, micro-mechanical and crystallographical aspects. It addresses scientists in these research fields and their students.

Shape Memory Alloys - Dimitris C. Lagoudas 2008-07-02

This book explores the modeling and engineering applications of shape memory alloys (SMAs), beginning with a rigorous introduction to continuum mechanics and continuum thermodynamics as related to SMA modeling. The text presents a unified approach to the constitutive modeling of SMAs.

Shape Memory Alloy Engineering - Antonio Concilio 2021-01-13

Shape Memory Alloy Engineering: For Aerospace, Structural and Biomedical Applications, Second Edition embraces new advancements in materials, systems and applications introduced since the first edition. Readers will gain an understanding of the intrinsic properties of SMAs and their characteristic state diagrams. Sections address modeling and design process aspects, explore recent applications, and discuss research activities aimed at making new devices for innovative implementations. The book discusses both the potential of these fascinating materials, their limitations in everyday life, and tactics on how to overcome some limitations in order to achieve proper design of useful SMA mechanisms. Provides a greatly expanded scope, looking at new applications of SMA devices and current research activities Covers all aspects of SMA technology - from a global state-of-the-art survey, to the classification of existing materials, basic material design, material manufacture, and from device engineering design to implementation within actual systems Presents the material within a modular architecture over different topics, from material conception to practical engineering realization

Phase Transformation Studies of TiNi and Cu-A1-Ni Shape-memory Alloys - Hanshen Zhang 2005

A Rate-independent Model for Phase Transformations in Shape-memory Alloys - Andreas Mainik 2006

Control Problems for Shape Memory Alloys with Constraints on the Shear Strain - Jan Sokołowski 1993