Morphotropic Phase Boundary Perovskites High Strain Piezoelectrics And Dielectric Ceramics Vol

The symposia Advances in Electroceramics and Microwave Materials and Their Applications were held during the 8th Pacific Rim Conference on Ceramic and Glass Technology (PACRIM 8) from May 31-June 5, 2009 in Vancouver, Canada. This issue contains 17 peer-reviewed papers (invited and contributed) from these two symposia. The book is logically organized and carefully selected articles give insight into multifunctional materials and systems and incorporates the latest developments related to multifunctional materials and systems including electroceramics and microwave materials.

"Covers topics such as nanostructuring, functional ceramics based on nanopowders micromechanical systems, self-assembling and patterning, porous structures etc."--

This book presents the state-of-the-art in simulation on supercomputers. Leading researchers present results achieved on systems of the High Performance Computing Center Stuttgart (HLRS) for the year 2010. The reports cover all fields of computational science and engineering, ranging from CFD to computational physics and chemistry to computer science, with a special emphasis on industrially relevant applications. Presenting results for both vector systems and microprocessor-based systems, the book makes it possible to compare the performance levels and usability of various architectures. As HLRS operates the largest NEC SX-8 vector system in the world, this book gives an excellent insight into the potential of vector systems, covering the main methods in high performance computing. Its outstanding results in achieving the highest performance for production codes are of particular interest for both scientists and engineers. The book includes a wealth of color illustrations and tables.

The use of high-temperature materials in current and future applications, including silicone materials for handling hot foods and metal alloys for developing high-speed aircraft and spacecraft systems, has generated a growing interest in high-temperature technologies. High Temperature Materials and Mechanisms explores a broad range of issues relate

The book is focused on the use of functional oxide and nitride films to enlarge the application range of MEMS (microelectromechanical systems), including micro-sensors, micro-actuators, transducers, and electronic components for microwaves and optical communications systems. Applications, emerging applications, fabrication technology and functioning issues are presented and discussed. The book covers the following topics: Part A: Applications and devices with electroceramic-based MEMS: Chemical microsensors Microactuators based on thin films Micromachined ultrasonic transducers Thick-film piezoelectric and magnetostrictive devices Pyroelectric microsystems RF bulk acoustic wave resonators and filters High frequency tunable devices MEMS for optical functionality Part B: Materials, fabrication technology, and functionality: Ceramic thick films for MEMS Piezoelectric thin films for MEMS Materials and technology in thin films for tunable high frequency devices Permittivity, tunability and loss in ferroelectrics for reconfigurable high frequency electronics Microfabrication of piezoelectric MEMS Nano patterning methods for electroceramics Soft lithography emerging techniques The book is addressed to engineers, scientists and researchers of various disciplines, device engineers, materials engineers, chemists, physicists and microtechnologists who are working and/or interested in this fast growing and highly promising field. The publication of this book follows a Special Issue on electroceramic-based MEMS that was published in the Journal of Electroceramics at the beginning of 2004. The ten invited papers of that special issue were adapted by the authors into chapters of the present book and five additional chapters were added.

This book is an excellent primer for students to learn about physical properties, particularly mechanical properties of heterogeneous and multiphase materials and the cultivation of physical insight. Written by a prominent author who pioneered many of the concepts, this book provides a comprehensive coverage of current topics in new heterogenous materials.Topics covered include:

This book is a printed edition of the Special Issue "Crystal Structure of Electroceramics" that was published in Crystals

The book deals with perovskite-type ferroelectric solid solutions for modern materials science and applications, solving problems of complicated heterophase/domain structures near the morphotropic phase boundary and applications to various systems with morphotropic phases. In this book domain state–interface diagrams are presented for the interpretation of heterophase states in perovskite-type ferroelectric solid solutions. It allows to describe the stress relief in the presence of polydomain phases, the behavior of unit-cell parameters of coexisting phases and the effect of external electric fields. The novelty of the book consists in (i) the first systematization of data about heterophase states and their evolution in ferroelectric solid solutions (ii) the general interpretation of heterophase and domain structures at changing temperature, composition or electric field (iii) the complete analysis of interconnection domain structures, unit-cell parameters changes, heterophase structures and stress relief.

This volume contains a collection of 40 papers from two symposia: Advanced Dielectric Materials and Multilayer Electronic Devices and High Strain Piezoelectric Materials, Devices and Applications. Topics include fundamental and historical perspectives of dielectric materials; relaxor materials and devices; high strain piezoelectric devices; advanced aspects of powder preparation, characterization, and properties; thin films; materials for low and high frequency applications; processing-structure-property-relationships; and future applications. Proceedings of the symposium held at the 105th Annual Meeting of The American Ceramic Society, April 27-30, 2003, in Nashville, Tennessee; Ceramic Transactions, Volume 150.

The focus of this collection is on recent research and development related to a variety of sensor technologies as well as the latest advances concerning the synthesis and

characterization of dielectric, piezoelectric, and ferroelectric materials.
Morphotropic Phase Boundary Perovskites, High Strain Piezoelectrics, and Dielectric CeramicsJohn Wiley & Sons
Perovskites have attracted great attention in the fields of energy storage, pollutant degradation as well as optoelectronic devices due to their excellent properties. This kind of material can be divided into two categories; inorganic perovskite represented by perovskite oxide and organic-inorganic hybrid perovskite, which have described the recent advancement separately in terms of catalysis and photoelectron applications. This book systematically illustrates the crystal structures, physic-chemical properties, fabrication process, and perovskite-related devices. In a word, perovskite has broad application prospects. However, the current challenges cannot be ignored, such as toxicity and stability.
Perovskites are among the most famous materials due to their exceptional properties: they present nearly all existing types of interesting properties, in particular as ferroics or multiferroics, they may be insulators, (super)conductors, or semiconductors, magnetoresistant, they are used in numerous devices, they present hundreds of variants and different crystalline phases and phase transitions, and recently appeared as probably the most promising materials for photovoltaics. With a crystal structure characterized by octahedra that share their corners, these materials belong to the wider category of « Framework Structure (FWS) materials » the structure of which is based on units (octahedra, tetrahedra, …) that share some of their corners (or edges) with their neighbours. This particular feature of FWS materials confers to them unique properties. This review volume is constituted of 26 chapters on different aspects, and is divided in two parts, « Fundamental aspects and general properties », and « Elaborated materials and applied properties ». Its main purpose is to attempt to identify the properties common to all members of the vast family of FWS materials, and understand their differences. Besides perovskites, derived compounds as 2D perovskites, Dion-Jacobson, Ruddlesden-Popper, Aurivillius, tungsten-bronzes, and others, are presented, and their preparation and/or properties as single crystals, ceramics, thin films, multilayers, nanomaterials, nanofibers, nanorods, etc, are discussed. We focus on new trends and important recent developments by leaving somewhat aside more classical aspects which can be easily found in older textbooks or review articles. Among most recent applications, this volume focuses on applications related with interactions with other molecules, on photovoltaics, and on memories, with a special attention to perovskite solar cells that have certainly attracted the most attention of researchers in recent years, opening extremely promising routes in photovoltaics. In conclusion, this book presents a collection of texts elucidating various aspects of the relation between structural organization (including dynamical aspects) and singular properties of framework crystals; it proposes a reasonable balance between experimental and theoretical results, and between fundamental aspects and applied properties. This volume can be approached on several levels (each chapter initially assumes that the reader is not a specialist in the subject, and is presented in a pedagogical way) : it is accessible to master or doctoral students, as well as to researchers who want to have informations on recent developments, who will find excellent detailed introductions up to hotsubjects. It may also be used by undergraduate students who should approach given subjects. The volume contains 800 pages written by about 70 authors from different countries, it has an index, and is completed by numerous figures to illustrate the text.
Advances in synthesis and characterization of dielectric, piezoelectric and ferroelectric thin films are included in this volume. Dielectric, piezoelectric and ferroelectric thin films have a tremendous impact on a variety of commercial and military systems including tunable microwave devices, memories, MEMS devices, actuators and sensors. Recent work on piezoelectric characterization, AFE to FE dielectric phase transformation dielectrics, solution and vapor deposited thin films, and materials integration are among the topics included. Novel approaches to nanostructuring, characterization of material properties and physical responses at the nanoscale also is included.
Students preparing to work with mechatronics, particularly with highly precise and smart actuators, face the challenge of designing and analyzing devices without formal and practical guidance in computer techniques. Finally there is a textbook that is as practical as it is authoritative: Kenji Uchino's FEM and Micromechatronics with ATILA Software. Ideal for Today's Computer-Based Curricula Every aspect of this book reflects its focus on being easy to use, easy to teach from, and above all, easy to implement. The first half of the text outlines the theory needed to develop and design smart actuators and transducers, while the second half walks students step-by-step through the software implementation using seven extensive examples. Even the book's lay-flat binding makes it easy for students to follow the text while working simultaneously at a computer. The companion CD-ROM supplies a free educational version of ATILA-Light. Unified Coverage for Integrated Technologies Covering the myriad challenges posed by smart transducers, the author introduces the fundamentals of piezoelectric and magnetostrictive devices, practical materials, device designs, drive and control techniques, and typical applications. Numerous problems and examples give students ample opportunity to put the concepts into practice. Outlining a complete treatment in 30 convenient 75 minute lessons, FEM and Micromechatronics with ATILA Software is a unique classroom text that students will continue to use throughout their entire careers.
Hybrid Composite Perovskite Materials: Design to Applications discusses the manufacturing, design and characterization of organic-inorganic perovskite composite materials. The book goes beyond the basics of characterization and discusses physical properties, surface morphology and environmental stability. Users will find extensive examples of real-world products that are suitable for the needs of the market. Following a logical order, the book begins with mathematical background and then covers innovative approaches to physical modeling, analysis and design techniques. Numerous examples illustrate the proposed methods and results, making this book a sound resource on the modern research application of perovskite composites with real commercial value. Discusses the composition of perovskite materials and their properties, manufacturing and environmental stability Includes both fundamentals and state-of-the-art developments Features the main types of applications, including solar cells, photovoltaics, sensors and optoelectronic devices

This comprehensive handbook and ready reference details all the main achievements in the field of perovskite-based and related mixed-oxide materials. The authors discuss, in an unbiased manner, the potentials as well as the challenges related to their use, thus offering new perspectives for research and development on both an academic and industrial level. The first volume begins by summarizing the different synthesis routes from molten salts at high temperatures to colloidal crystal template methods, before going on to focus on the physical properties of the resulting materials and their related applications in the fields of electronics, energy harvesting, and storage as well as electromechanics and superconductivity. The second volume is dedicated to the catalytic applications of perovskites and related mixed oxides, including, but not limited to total oxidation of hydrocarbons, dry reforming of methane and denitrogenation. The concluding section deals with the development of chemical reactors and novel perovskite-based applications, such as fuel cells and high-performance ceramic membranes. Throughout, the contributions clearly point out the intimate links between structure, properties and applications of these materials, making this an invaluable tool for materials scientists and for catalytic and physical chemists.

Here, more than 20 experts from leading research institutes around the world present the entire scope of this rapidly developing field. In so doing, they cover a wide range of topics, including the characterization and investigation of structural, dielectric and piezoelectric properties of ceramic materials, a well as phase transitions, electrical and optical properties and microscopic investigations. Another feature is a complete profile of the properties of polar oxides -- from their proof to their latest applications. Throughout, the authors review, discuss and assess the material properties with regard to new and advanced characterization and imaging techniques. For physicists, physicochemists, semiconductor and solid state physicists, materials scientists, and students of chemistry and physics.

This comprehensive book covers recent developments in advanced dielectric, piezoelectric and ferroelectric materials. Dielectric materials such as ceramics are used to manufacture microelectronic devices. Piezoelectric components have been used for many years in radioelectrics, time-keeping and, more recently, in microprocessor-based devices. Ferroelectric materials are widely used in various devices such as piezoelectric/electrostrictive transducers and actuators, pyroelectric infrared detectors, optical integrated circuits, optical data storage and display devices. The book is divided into eight parts under the general headings: High strain high performance piezo- and ferroelectric single crystals; Electric field-induced effects and domain engineering; Morphotropic phase boundary related phenomena; High power piezoelectric and microwave dielectric materials; Nanoscale piezo- and ferroelectrics; Piezo- and ferroelectric films; Novel processing and new materials; Novel properties of ferroelectrics and related materials. Each chapter looks at key recent research on these materials, their properties and potential applications. Advanced dielectric, piezoelectric and ferroelectric materials is an important reference tool for all those working in the area of electrical and electronic materials in general and dielectrics, piezoelectrics and ferroelectrics in particular. Covers the latest developments in advanced dielectric, piezoelectric and ferroelectric materials Includes topics such as high strain high performance piezo and ferroelectric single crystals Discusses novel processing and new materials, and novel properties of ferroelectrics and related materials

Although ceramics have been known to mankind literally for millennia, research has never ceased. Apart from the classic uses as a bulk material in pottery, construction, and decoration, the latter half of the twentieth century saw an explosive growth of application fields, such as electrical and thermal insulators, wear-resistant bearings, surface coatings, lightweight armour, or aerospace materials. In addition to plain, hard solids, modern ceramics come in many new guises such as fabrics, ultrathin films, microstructures and hybrid composites. Built on the solid foundations laid down by the 20-volume series Materials Science and Technology, Ceramics Science and Technology picks out this exciting material class and illuminates it from all sides. Materials scientists, engineers, chemists, biochemists, physicists and medical researchers alike will find this work a treasure trove for a wide range of ceramics knowledge from theory and fundamentals to practical approaches and problem solutions.

Piezoelectric materials produce electric charges on their surfaces as a consequence of applying mechanical stress. They are used in the fabrication of a growing range of devices such as transducers (used, for example, in ultrasound scanning), actuators (deployed in such areas as vibration suppression in optical and microelectronic engineering), pressure sensor devices (such as gyroscopes) and increasingly as a way of producing energy. Their versatility has led to a wealth of research to broaden the range of piezoelectric materials and their potential uses. Advanced piezoelectric materials: science and technology provides a comprehensive review of these new materials, their properties, methods of manufacture and applications. After an introductory overview of the development of piezoelectric materials, Part one reviews the various types of piezoelectric material, ranging from lead zirconate titanate (PZT) piezo-ceramics, relaxor ferroelectric ceramics, lead-free piezo-ceramics, quartz-based piezoelectric materials, the use of lithium niobate and lithium in piezoelectrics, single crystal piezoelectric materials, electroactive polymers (EAP) and piezoelectric composite materials. Part two discusses how to design and fabricate piezo-materials with chapters on piezo-ceramics, single crystal preparation techniques, thin film technologies, aerosol techniques and manufacturing technologies for piezoelectric transducers. The final part of the book looks at applications such as high-power piezoelectric materials and actuators as well as the performance of piezoelectric materials under stress. With its distinguished editor and international team of expert contributors Advanced piezoelectric materials: science and technology is a standard reference for all those researching piezoelectric materials and using them to develop new devices in such areas as microelectronics, optical, sound, structural and biomedical engineering. Provides a comprehensive review of the new materials, their properties and methods of manufacture and application Explores the development of piezoelectric materials from the historical background to the present status Features an overview of manufacturing methods for piezoelectric ceramic materials including design considerations

Volume is indexed by Thomson Reuters CPCI-S (WoS).

This book is devoted to the systematic description of the role of microgeometry of modern piezo-active composites in the formation of their piezoelectric sensitivity. In five chapters, the authors analyse kinds of piezoelectric sensitivity for piezo-active composites with specific connectivity patterns and links between the microgeometric feature and piezoelectric response. The role of components and microgeometric factors is discussed in the context of the piezoelectric properties and their anisotropy in the composites. Interrelations between different types of the piezoelectric coefficients are highlighted. This book fills a gap in piezoelectric materials science and provides readers with data on the piezoelectric performance of novel composite materials that are suitable for sensor, transducer, hydroacoustic, energy-harvesting, and other applications.

Ferroelectric materials have been and still are widely used in many applications, that have moved from sonar towards breakthrough technologies such as memories or optical devices. This book is a part of a four volume collection (covering material aspects, physical effects, characterization and modeling, and applications) and focuses on the underlying mechanisms of ferroelectric materials, including general ferroelectric effect, piezoelectricity, optical properties, and multiferroic and magnetoelectric devices. The aim of this book is to provide an up-to-date review of recent scientific findings and recent advances in the field of ferroelectric systems, allowing a deep understanding of the physical aspect of ferroelectricity.

The Springer Handbook of Nanomaterials covers the description of materials which have dimension on the "nanoscale". The description of the nanomaterials in this Handbook follows the thorough but concise explanation of the synergy of structure, properties, processing and applications of the given material. The Handbook mainly describes materials in their solid phase; exceptions might be e.g. small sized liquid aerosols or gas bubbles in liquids. The materials are organized by their dimensionality. Zero dimensional structures collect clusters, nanoparticles and quantum dots, one dimensional are nanowires and nanotubes, while two dimensional are represented by thin films and surfaces. The chapters in these larger topics are written on a specific materials and dimensionality combination, e.g. ceramic nanowires. Chapters are authored by well-established and well-known scientists of the particular field. They have measurable part of publications and an important role in establishing new knowledge of the particular field.

Collection of selected, peer reviewed papers from the 2014 International Conference on Materials Science and Engineering Technology (MSET 2014), June 28-29, 2014, Shanghai, China. The 422 papers are grouped as follows: Chapter 1: Polymers and Composites, Chapter 2: Ceramics and Functional Materials, Chapter 3: Films and Membranes, Chapter 4: Nanomaterials and Applied Nanotechnologies, Chapter 5: Materials for Energy Sources and Energy Supply, Chapter 6: Chemical Physics, Chapter 7: Materials and Technologies in Microelectronics, Chapter 8: Biomaterials, Biotechnologies and Pharmaceutics, Chapter 9: Materials and Technologies in Environmental Engineering, Chapter 10: Materials and Technologies of Chemical Industry, Chapter 11: Corrosion and Surface of Materials, Technologies of Coatings, Chapter 12: Alloys and Steels, Metallurgical Technologies, Chapter 13: Building Materials and Technologies in Construction, Chapter 14: Technologies and Materials in Oil Industry, Chapter 15: Methods and Devices of Measurements in Materials Engineering, Chapter 16: Technologies and Equipment for Manufacturing and Processing of Materials, Chapter 17: Research in Area of Applied Materials, Chapter 18: General Mechanical Engineering, Chapter 19: Mechatronics, Control and Automation, Chapter 20: Power Engineering, Chapter 21: Electronic Engineering, Chapter 22: Measurements, Data and Signal Processing, Computational Methods and Algorithms, Chapter 23: Communication and Information Technologies, Chapter 24: Product Design and Engineering Management, Chapter 25: Geophysical Research and Resources

Proceedings of the Symposium on Dielectric Materials and Multilayer Electronic Devices and the Symposium on Morphotropic Phase Boundary Phenomena and Perovskite Materials, held April 28 - May 1, 2002, in St. Louis, Missouri, during the 104th Annual Meeting of the American Ceramic Society, and the Focused Session on High Strain Piezoelectrics, held April 22-25, 2001, in Indianapolis, Indiana, during the 103rd Annual Meeting of the American Ceramic Society.

Discovered in 1880, piezoelectric materials play a key role in an innovative market of several billions of dollars. Recent advances in applications derive from new materials and their development, as well as to new market requirements. With the exception of quartz, ferroelectric materials are used for they offer both high efficiency and sufficient versatility to meet adequately the multidimensional requirements for application. Consequently, strong emphasis is placed on tailoring materials and technology, whether one deals with single crystals, ceramics or plastic materials. Tailoring requires a basic understanding of both physical principles and technical possibilities and limitations. This report elucidates these developments by a broad spectrum of examples, comprising ultrasound in medicine and defence industry, frequency control, signal processing by SAW-devices, sensors, actuators, including novel valves for modern motor management. It delivers a mutual fertilization of technology push and market pull that should be of interest not only to materials scientists or engineers but also to managers who dedicate themselves to a sound future-oriented R&D policy.

This book systematically reviews the history of lead-free piezoelectric materials, including the latest research. It also addresses a number of important issues, such as new types of materials prepared in a multitude of sizes, structural and physical properties, and potential applications for high-performance devices. Further, it examines in detail the state of the art in lead-free piezoelectric materials, focusing on the pathways to modify different structures and achieve enhanced physical properties and new functional behavior. Lastly, it discusses the prospects for potential future developments in lead-free piezoelectric materials across disciplines and for multifunctional applications. Given its breadth of coverage, the book offers a comprehensive resource for graduate students, academic researchers, development scientists, materials producers, device designers and applications engineers who are working on or are interested in advanced lead-free piezoelectric materials.

Piezoelectric energy is a renewable alternative energy source that operates on a smaller scale than renewable energy generation plants which generate Mega-Giga Watts of power. Its potential to 'eliminate' contemporary batteries, which are classified as hazardous wastes, makes it an important technological advancement in a world increasingly concerned about eliminating waste, increasing sustainability and shifting to more 'green' consumption habits.Authored by a pioneer of piezoelectric actuators and piezoelectric energy harvesting, this unique compendium provides a solid theoretical background of piezoelectrics, practical material selection, device design optimization, and energy harvesting electric circuits. Included in each chapter are a list of chapter essentials, check points, example problems and solutions, and practice problems.Written for advanced undergraduate and graduate students, university researchers, and industry engineers studying or working in the field of piezoelectric energy harvesting systems, the useful reference text provides readers with the essential knowledge to conduct research and raises readers' awareness of known pitfalls and mis-directions in the field.

Handbook of Silicon Based MEMS Materials and Technologies, Third Edition is a comprehensive guide to MEMS materials, technologies, and manufacturing with a particular emphasis on silicon as the most important starting material used in MEMS. The book explains the fundamentals, properties (mechanical, electrostatic, optical, etc.), materials selection, preparation, modeling, manufacturing, processing,

system integration, measurement, and materials characterization techniques of MEMS structures. The third edition of this book provides an important up-to-date overview of the current and emerging technologies in MEMS making it a key reference for MEMS professionals, engineers, and researchers alike, and at the same time an essential education material for undergraduate and graduate students. Provides comprehensive overview of leading-edge MEMS manufacturing technologies through the supply chain from silicon ingot growth to device fabrication and integration with sensor/actuator controlling circuits Explains the properties, manufacturing, processing, measuring and modeling methods of MEMS structures Reviews the current and future options for hermetic encapsulation and introduces how to utilize wafer level packaging and 3D integration technologies for package cost reduction and performance improvements Geared towards practical applications presenting several modern MEMS devices including inertial sensors, microphones, pressure sensors and micromirrors

This is the first text to cover all aspects of solution processed functional oxide thin-films. Chemical Solution Deposition (CSD) comprises all solution based thin- film deposition techniques, which involve chemical reactions of precursors during the formation of the oxide films, i. e. sol-gel type routes, metallo-organic decomposition routes, hybrid routes, etc. While the development of sol-gel type processes for optical coatings on glass by silicon dioxide and titanium dioxide dates from the mid-20th century, the first CSD derived electronic oxide thin films, such as lead zirconate titanate, were prepared in the 1980's. Since then CSD has emerged as a highly flexible and cost-effective technique for the fabrication of a very wide variety of functional oxide thin films. Application areas include, for example, integrated dielectric capacitors, ferroelectric random access memories, pyroelectric infrared detectors, piezoelectric micro-electromechanical systems, antireflective coatings, optical filters, conducting-, transparent conducting-, and superconducting layers, luminescent coatings, gas sensors, thin film solid-oxide fuel cells, and photoelectrocatalytic solar cells. In the appendix detailed "cooking recipes" for selected material systems are offered.

This book presents theory, fundamentals and applications of ferroelectricy. 24 chapters gather reviews and research reports covering the spectrum of ferroelectricity. It describes the current levels of understanding of various aspects of ferroelectricity as presented by authorities in the field. Topics include relaxors, piezoelectrics, microscale and nanoscale studies, polymers and composites, unusual properties, and techniques and devices. The book is intended for physicists, engineers and materials scientists working with ferroelectric materials.

Ferroelectric thin films continue to attract much attention due to their developing applications in memory devices, FeRAM, infrared sensors, piezoelectric sensors and actuators. This book, aimed at students, researchers and developers, gives detailed information about the basic properties of these materials and the associated device physics. The contributing authors are acknowledged experts in the field.

The number of ceramic materials with a perovskite type structure islarge and of considerable technological importance due to theirrich crystal chemistry and structure-property relationships.Applications include multilayer capacitators, piezoelectrictransducers, PTC thermistors, electrooptical modulators, opticalswitches, dielectric resonators, thick film resistors, electronicsensors, electrorestrictive actuators, magnetic bubble memorydevices, laser host materials, ferromagnetic materials, refractoryelectrodes, second harmonic generators, batteries, ceramicelectrodes, thermoelectric devices, and high temperaturesuperconductors. This volume contains papers on the research and development of newperovskite materials for various applications including doping ofexisting perovskite materials as well as processing for improvedproperties.

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