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# High Performance Non-Oxide Ceramics II



Springer

# High Performance Nonoxide Ceramics II

**R. Haubner**



## **High Performance Nonoxide Ceramics II:**

**High Performance Non-Oxide Ceramics II** R. Haubner, 2002-07-03 The nitrides and carbides of boron and silicon are proving to be an excellent choice when selecting materials for the design of devices that are to be employed under particularly demanding environmental and thermal conditions The high degree of cross linking due to the preferred coordination numbers of the predominantly covalently bonded constituents equalling or exceeding three lends these non oxidic ceramics a high kinetic stability and is regarded as the microscopic origin of their impressive thermal and mechanical durability Thus it does not come as a surprise that the chemistry the physical properties and the engineering of the corresponding binary ternary and even quaternary compounds have been the subject of intensive and sustained efforts in research and development In the five reviews presented in the volumes 101 and 102 of Structure and Bonding an attempt has been made to cover both the essential and the most recent advances achieved in this particular field of materials research The scope of the individual contributions is such as to address both graduate students specializing in ceramic materials and all scientists in academia or industry dealing with materials research and development Each review provides in its introductory part the chemical physical and to some extent historical background of the respective material and then focuses on the most relevant and the most recent achievements

### **High Performance Non-Oxide Ceramics II M.**

Jansen, 2003-08-25 The nitrides and carbides of boron and silicon are proving to be an excellent choice when selecting materials for the design of devices that are to be employed under particularly demanding environmental and thermal conditions The high degree of cross linking due to the preferred coordination numbers of the predominantly covalently bonded constituents equalling or exceeding three lends these non oxidic ceramics a high kinetic stability and is regarded as the microscopic origin of their impressive thermal and mechanical durability Thus it does not come as a surprise that the chemistry the physical properties and the engineering of the corresponding binary ternary and even quaternary compounds have been the subject of intensive and sustained efforts in research and development In the five reviews presented in the volumes 101 and 102 of Structure and Bonding an attempt has been made to cover both the essential and the most recent advances achieved in this particular field of materials research The scope of the individual contributions is such as to address both graduate students specializing in ceramic materials and all scientists in academia or industry dealing with materials research and development Each review provides in its introductory part the chemical physical and to some extent historical background of the respective material and then focuses on the most relevant and the most recent achievements

**High Performance Non-Oxide Ceramics I** F. Aldinger, 2002-07-03 The nitrides and carbides of boron and silicon are proving to be an excellent choice when selecting materials for the design of devices that are to be employed under particularly demanding environmental and thermal conditions The high degree of cross linking due to the preferred coordination numbers of the predominantly covalently bonded constituents equalling or exceeding three lends these non oxidic ceramics a high

kinetic stability and is regarded as the microscopic origin of their impressive thermal and mechanical durability. Thus it does not come as a surprise that the chemistry, the physical properties and the engineering of the corresponding binary, ternary and even quaternary compounds have been the subject of intensive and sustained efforts in research and development. In the five reviews presented in the volumes 101 and 102 of *Structure and Bonding*, an attempt has been made to cover both the essential and the most recent advances achieved in this particular field of materials research. The scope of the individual contributions is such as to address both graduate students specializing in ceramic materials and all scientists in academia or industry dealing with materials research and development. Each review provides in its introductory part the chemical, physical and to some extent historical background of the respective material and then focuses on the most relevant and the most recent achievements.

**Silicon Nitride Bioceramics** B. Sonny Bal, Bryan J. McEntire, Giuseppe Pezzotti, 2024-10-14  
This book offers a comprehensive exploration of silicon nitride biomaterials encompassing both established and emerging applications. Key topics include a foundational overview of biomaterials followed by an in-depth examination of silicon nitride's structure, bulk properties, processing techniques, surface chemistry and its critical functionalities: osteoconductivity and antipathogenicity. The text delves into silicon nitride biocomposites and coatings, exploring their potential in various fields. Dedicated chapters address the use of silicon nitride in spinal surgery and total joint arthroplasty, providing valuable insights. Additionally, a critical comparison between silicon nitride and zirconia toughened alumina is presented. The book concludes with a discussion of silicon nitride's promising future applications within dentistry and other emerging fields. This comprehensive resource serves as an ideal reference for ceramic scientists, students, orthopedic and neurosurgeons and professionals in the orthopedic implant industry seeking to expand their knowledge of silicon nitride biomaterials and their diverse applications. This book also provides the latest research on and applications of silicon nitride biomaterials for spine surgery and additive manufacturing. Broadens reader understanding of silicon nitride composites and the antimicrobial properties of silicon nitride. Thoroughly details the surface chemistry of silicon nitride in artificial joint environments and future applications of silicon nitride biomaterials.

Principles and Applications of Density Functional Theory in Inorganic Chemistry I Nikolas Kaltsoyannis, John E. McGrady, 2004-09-14  
It is difficult to overestimate the impact that density functional theory has had on computational quantum chemistry over the last two decades. Indeed, this period has seen it grow from little more than a theoretical curiosity to become a central tool in the computational chemist's armoury. Arguably, no area of chemistry has benefited more from the meteoric rise in density functional theory than inorganic chemistry: the ability to obtain reliable results in feasible timescales on systems containing heavy elements such as the d and f transition metals has led to an enormous growth in computational inorganic chemistry. The inorganic chemical literature reflects this growth: it is almost impossible to open a modern inorganic chemistry journal without finding several papers devoted exclusively or in part to density functional theory calculations. The real importance of the rise in density functional theory in inorganic chemistry is

undoubtedly the much closer synergy between theory and experiment than was previously possible. In these volumes world leading researchers describe recent developments in the density functional theory and its applications in modern inorganic and bioinorganic chemistry. These articles address key issues in both solid state and molecular inorganic chemistry such as spectroscopy, mechanisms, catalysis, bonding, and magnetism. The articles in volume I are more focussed on advances in density functional methodology while those in Volume II deal more with applications, although this is by no means a rigid distinction.

Micro and Nanostructured Composite Materials for Neutron Shielding Applications Sajith Thottathil Abdulrahman, Sabu Thomas, Zakiah Ahmad, 2020-06-30. *Micro and Nanostructured Composite Materials for Neutron Shielding Applications* presents recent developments and future possibilities for neutron shielding materials. Emphasis is placed on the correlation between the morphology, shielding mechanisms, and other desired properties including their mechanical and thermal properties. The effect of neutron absorbing fillers including their size on final properties is also examined, as are recent advancements in preparation, characterization, and simulation techniques. Written by specialists in their respective fields, this comprehensive resource will help professionals and students understand the fundamentals of neutron shielding as well as the properties of micro and nanopolymer based composites, concrete materials, alloy materials, and metal ceramic composites. Provides an up to date understanding of the fundamentals of shielding mechanisms, morphology, and material property correlations. Covers a broad range of micro and nano composite materials for neutron shielding. Discusses recent advances surrounding the synthesis and processing of nanostructures and nanocomposite materials. *Polymer Nanocomposites* Xingyi Huang, Chunyi Zhi, 2016-05-06. This book focuses on the fundamental principles and recent progress in the field of electrical and thermal properties of polymer nanocomposites. The physical and chemical natures determining the electrical and thermal properties of polymer nanocomposites are discussed in detail. The authors describe the range of traditional and emerging polymer nanocomposites from nanoparticle and polymer composites to novel nanostructure based polymer nanocomposites. They include novel properties and potential applications such as high  $k$ , low  $k$ , high thermal conductivity, antistatic, high voltage insulation, electric stress control, and thermal energy conversion among others. **1981**

**New England Section Topical Meeting on Nonoxide Ceramics** William J. Smothers, 2009-09-28. This volume is part of the Ceramic Engineering and Science Proceeding CESP series. This series contains a collection of papers dealing with issues in both traditional ceramics, i.e. glass, whitewares, refractories, and porcelain enamel, and advanced ceramics. Topics covered in the area of advanced ceramic include bioceramics, nanomaterials, composites, solid oxide fuel cells, mechanical properties, and structural design, advanced ceramic coatings, ceramic armor, porous ceramics, and more. *Non-Oxide Technical and Engineering Ceramics* S. Hampshire, 2012-12-06. Conferences on technical and engineering ceramics are held with increasing frequency, having become fashionable because the potential of ceramics in profitable growth industries is an urgent matter of considerable debate and discussion. Japanese predictions are that the market value of ceramics will grow 10% at about 10% per

annum to reach at least 10 by the end of the century Seventy per cent of this market will be in electroceramics applications for which include insulating substrates in integrated circuits ferroelectric capacitors piezoelectric oscillators and transducers ferrite magnets and ion conducting solid electrolytes and sensors All these are oxides and so are excluded by the title of the Limerick Conference Why Non oxide The other major ceramics potential is in structural engineering components and engine applications Here the greatest impetus to research and development has been the attempt to produce a ceramic gas turbine Heat engines become more efficient as their working temperature increases but nickel base superalloy engines have about reached their limit Compared with metals ceramics have higher strengths at high temperatures better oxidation and corrosion resistance and are also less dense In general ceramics have better properties above about 1000 C except in one respect their inherent brittleness The work of fracture is therefore much smaller than for metals and so the permitted flaw size is also smaller

**SiBCN Ceramics and Composites Prepared by Mechanical Alloying** Daxin Li, Dechang Jia, Zhihua Yang, Yu Zhou, 2024-06-18 This book mainly provides a comprehensive treatment of the SiBCN ceramics and their matrix CMCs aspect of theme content including material design and preparation microstructural feature and evolutionary process mechanical and thermophysical properties resistance to oxidation thermal shock and ablation and the mechanisms of oxidation ablation and crystallization of SiBCN based materials Furthermore this book offers the necessary fundamentals to ensure a basic understanding of the structure and properties of metastable Si based ceramics and their composites for undergraduate and postgraduate students in materials related disciplines in higher education as well as for scientific research production development and technical management in the fields of metastable materials mechanical alloying processing nonequilibrium structure organic inorganic composites etc

*Ceramics Science and Technology, Volume 3* Ralf Riedel, I-Wei Chen, 2011-12-15 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

Comprehensive Hard Materials Daniele Mari, Luis Miguel, Christoph E. Nebel, 2014-02-01 Comprehensive Hard Materials Three Volume Set deals with the production uses and properties of the carbides nitrides and borides of these metals and those of titanium as well as tools of ceramics the superhard boron nitrides and diamond and related compounds Articles include the technologies of powder production including their precursor

materials milling granulation cold and hot compaction sintering hot isostatic pressing hot pressing injection moulding as well as on the coating technologies for refractory metals hard metals and hard materials The characterization testing quality assurance and applications are also covered Comprehensive Hard Materials provides meaningful insights on materials at the leading edge of technology It aids continued research and development of these materials and as such it is a critical information resource to academics and industry professionals facing the technological challenges of the future Hard materials operate at the leading edge of technology and continued research and development of such materials is critical to meet the technological challenges of the future Users of this work can improve their knowledge of basic principles and gain a better understanding of process structure property relationships With the convergence of nanotechnology coating techniques and functionally graded materials to the cognitive science of cemented carbides cermets advanced ceramics super hard materials and composites it is evident that the full potential of this class of materials is far from exhausted This work unites these important areas of research and will provide useful insights to users through its extensive cross referencing and thematic presentation To link academic to industrial usage of hard materials and vice versa this work deals with the production uses and properties of the carbides nitrides and borides of these metals and those of titanium as well as tools of ceramics the superhard boron nitrides and diamond and related compounds

**In situ generated  $\beta$ -Yb<sub>2</sub>Si<sub>2</sub>O<sub>7</sub> environmental barrier coatings to protect non-oxide silicon-based ceramics in gas turbines (Band 16)** Mateus Lenz Leite, 2022-02-25 In face of an accelerating climate change the reduction and substitution of fossil fuels is crucial to decarbonize energy production Gas turbines can operate with versatile fuel sources like natural gas and future fuels such as hydrogen and ammonia In a next future thermal efficiencies above 65% are expected to be achieved by implementing non oxide silicon based i e Si N SiC and SiC SiC ceramic components However water vapor is one of the main combustion products which leads to rapid corrosion due to the volatilization of the protective SiO layer above 1200 C Hence an in situ generated Yb Si O double layered environmental barrier coating system composed of silazanes and the active fillers Yb<sub>2</sub>O<sub>3</sub> and Si was processed at 1415 C for 5 h in air to protect Si<sub>3</sub>N<sub>4</sub> SiC and SiC SiC from corrosion The easy to apply coating system exhibits a dense microstructure with a thickness of up to 150 m besides an excellent adhesion strength 36.9 ± 6.2 MPa hardness 6.9 ± 1.6 GPa and scratch resistance 28 N It remarkably overcomes over 15 thermal cycles between 1200 and 20 C and shows almost no mass loss after harsh hot gas corrosion at 1200 C for 200 h pH<sub>2</sub>O 0.15 atm v 100 m s

**Progress in Nitrogen Ceramics** F.L. Riley, 2012-12-06 The first NATO Advanced Study Institute on Nitrogen Ceramics held in 1976 at Canterbury came at a particularly significant moment in the development of this subject The five year period 1971-75 had been an especially fruitful one in very many respects for work in the areas of covalent materials in general and of the nitrides in particular The Institute was therefore able to capture fully the spirit of excitement and adventure engendered by the outputs of numerous national research programmes as well as those of many smaller research groups concerning ceramics

potentially suitable for applications in a high temperature engineering context. It reflected accurately the state of knowledge with respect to the basic science, the powder technology and the properties of materials based on silicon nitride and associated systems. The Proceedings of the Institute thus provided a good record for workers already in the field and a useful textbook for newcomers to the subject of nitrogen ceramics. The Canterbury Advanced Study Institute had a valuable educational and social function in bringing together for two weeks a large proportion of those workers most closely involved at that time with the nitrogen ceramics. The atmosphere of this meeting, providing both intensive discussions and informal contacts, made a lasting impression on the participants and inevitably the question was raised of whether and when a second Advanced Study Institute might be held on this subject. *Formation of Silicon Nitride* Raymond C. Sangster, 2005-06-01

From the 19th to the 21st Century **Ceramic Science and Engineering** Kamakhya Prakash Misra, R.D.K.

Misra, 2022-05-03 *Ceramic Science and Engineering Basics to Recent Advancements* covers the fundamentals, classification and applications surrounding ceramic engineering. In addition, the book contains an extensive review of the current published literature on established ceramic materials. Other sections present an extensive review of up-to-date research on new innovative ceramic materials and reviews recently published articles, case studies, and the latest research outputs. The book will be an essential reference resource for materials scientists, physicists, chemists, and engineers, postgraduate students, early career researchers, and industrial researchers working in R&D in the development of ceramic materials. Ceramic engineering deals with the science and technology of creating objects from inorganic and non-metallic materials. It combines the principles of chemistry, physics, and engineering. Fiber optic devices, microprocessors, and solar panels are just a few examples of ceramic engineering being applied in everyday life. Advanced ceramics such as alumina, aluminum nitride, zirconia, ZnO, silicon carbide, silicon nitride, and titania-based materials, each of which have their own specific characteristics, offer an economic and high performance alternative to more conventional materials such as glass, metals, and plastics, which are also discussed. Covers environmental barrier ceramic coatings, advanced ceramic conductive fuel cells, processing and machining technology in ceramic and composite materials, photoluminescent ceramic materials, perovskite ceramics, and bioinspired ceramic materials. Reviews both conventional established ceramics and new innovative advanced ceramics. Contains an extensive review of the current published literature on established ceramic materials. *An Introduction to Ceramics and Refractories* A. O. Surendranathan, 2014-12-10 This book covers the fundamental aspects of ceramics and refractories. All refractories are ceramics, but all ceramics are not refractories. The book classifies and describes these materials and examines their availability in nature. It examines the availability of these materials in nature, how they are extracted from nature, and how some of these materials are synthesized and explains their structure-property correlation. It also addresses how they are designed for various applications and more. **Ceramic Armor Materials by Design** James W.

McCauley, Andrew Crowson, William A. Gooch, Jr., A. M. Rajendran, Stephan J. Bless, Kathryn Logan, Michael



Normandia, Steven Wax, 2012-03-28 This proceedings book brings together 55 papers on ceramic armor presented by authorities from around the world covering topics such as ceramic armor development processing manufacturing and insertion This book will be of great interest to armor researchers in university industry and government laboratories as well as those industries involved in ceramic armor and high performance structural ceramics Papers were presented at PacRim IV An International Conference on Advanced Ceramics and Glasses Wailea Maui Hawaii USA 2001 650 pages

*Surface-Functionalized Ceramics* Laura Treccani, Fabian Meder, 2022-12-12 Surface Functionalized Ceramics Focused coverage of making and using functional ceramic materials for a wide variety of scientific and technical applications Surface Functionalized Ceramics provides a comprehensive overview of surface functionalization approaches for ceramic materials including alumina zirconia titania and silica and their uses as sensors chemical and biological probes chromatographic supports for bio molecule purification and analysis and adsorbents for toxic substances and pollutants Overall the text provides a broad picture of the enormous possibilities offered by surface functionalization and addresses the current challenges regarding surface analysis characterization and stability As a well rounded resource the text points out opportunities of surface functionalized ceramics their issues such as achieving surface stability and complex analysis and how to counter them Edited by two experts in the field of advanced materials surfaces Surface Functionalized Ceramics covers topics such as Processing methods for advanced ceramics surface modification of ceramic materials and methods for electrokinetic surface characteristics Surface imaging and chemical surface analysis using atomic force microscopy Surface chemical analysis and ceramic enhanced analytics Biological and living matter surface interactions including protein adsorption mechanisms as well as bacteria behavior in terms of biofilm formation and prevention for antibacterial applications Mesoporous silica and organosilica biosensors for water quality and environmental monitoring plus ceramic based adsorbents in bioproduct recovery and purification For professionals researchers and academics in the fields of materials science biotechnology biotechnological industry environmental sciences and ceramics industry Surface Functionalized Ceramics is a one stop reference on the subject that provides different approaches to obtain surfaces of ceramic materials that perform desired functions

**Ceramic Fibers and Coatings** National Research Council, Division on Engineering and Physical Sciences, National Materials Advisory Board, Commission on Engineering and Technical Systems, Committee on Advanced Fibers for High-Temperature Ceramic Composites, 1998-04-21 High temperature ceramic fibers are the key components of ceramic matrix composites CMCs Ceramic fiber properties strength temperature and creep resistance for example along with the debonding characteristics of their coatings determine the properties of CMCs This report outlines the state of the art in high temperature ceramic fibers and coatings assesses fibers and coatings in terms of future needs and recommends promising avenues of research CMCs are also discussed in this report to provide a context for discussing high temperature ceramic fibers and coatings

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