Book Reviews

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1 Materials Research Society, Symposium Proceedings Volume 890, Surface Engineering for Manufacturing Applications, Symposium held November 28–December 1, 2005, Boston, Massachusetts, USA
by: S.J. Bull, P.R. Chalker, S.C. Chen, W.J. Meng and R. Maboudian
Published 2006
by MRS, Materials Research Society
506 Keystone Drive, Warrendale, Pennsylvania, PA 15086, USA, 308pp
ISBN: 1558998446

Surface interactions and surface modifications have become increasingly critical for a broad range of manufacturing sectors, but also in manufacturing processes for microelectronics, optics, and other emerging industries such as micro-/nano-electro-mechanical-systems (MEMS/NEMS). Many applications demand engineered surfaces at different length scales that will function under extreme conditions.

The span of papers included within this proceedings from symposium y, 'Surface Engineering for Manufacturing Applications', held November 28–December 1 at the 2005 MRS Fall Meeting in Boston, Massachusetts, testifies to the growing importance of controlling surface interactions and engineering surface properties in modern manufacturing processes. In the field of tribological coatings, the increasing sophistication of coating processes to provide control over materials and composition gradients is being exploited to tailor properties such as adhesion, stresses, thermal barrier and wear resistance. Understanding of the influence of nanostructure in coatings, either in the form of super-lattices or nano-composites has become pivotal in the development of hard and wear-resistant materials.

Modelling and simulation continue to make more sophisticated contributions to the understanding and predication of surface properties and surface interactions. Recent advances in this field have particularly focused on the microstructure and organisation of organic thin films. In tribology, the combination of modelling with experimental probe techniques is increasing our understanding of erosion and wears mechanisms.

2 Ceramics Science and Technology, Volume 2: Properties
by: Ralf Riedel and I-Wei Chen
Published 2010
by Wiley-VCH Verlag GmbH & Co. KgaA
P.O. Box 10 11 61, 69451 Weinheim, Boschstrasse 12,
69469 Weinheim, Germany, 862pp
ISBN: 978-3-527-31156-9

Besides metals and polymers, advanced ceramics represent one of the most promising classes of materials for the key technologies of the 21st century. Recent developments in the field of ceramics have included a selection of synthesis, processing and sintering techniques applied to the production of novel structural and functional ceramics and ceramic composites.

The four-volume series of ceramics science and technology covers various aspects of modern trends in advanced ceramics, and reflects the status quo of the latest achievements in ceramics science and developments. The contributions highlight the increasing technological significance of advanced ceramic materials, and present concepts for ceramics by considering a broad spectrum of length scale, starting from the atomic level by discussing amorphous and crystalline solid-state structural features, thin films and multiphase (composite) structures. Volume 2 focuses first, on the distinct ceramic materials classes, namely oxides, carbides and nitrides, and second on the physical and mechanical properties of advanced ceramics. The series will be completed by Volume 4, which will be devoted to the application of engineering and functional ceramics.

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 20th 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, ultra-thin films, microstructures and hybrid composites.

Built on the solid foundations laid down by the 20-volume series material science and technology, ceramics science and technology picks out this exciting material class and illuminates it from all sides.

The book contains issues given in chapters:

- *Ceramic material classes*: ceramic oxides, nitrides, gallium nitride and oxonitrides, Silicon carbide- and boron carbide-based hard materials, complex oxynitrides, perovskites, the Mn + AXn Phasis and their properties.
- *Structures and properties*: structure-property relations, dislocations in ceramics, defect structure, non-stoichiometry, and non-stoichiometry relaxation of complex oxides, interfaces and microstructures in materials.
- *Mechanical properties*: fracture of ceramics, creep mechanisms in commercial grades of silicon nitride, fracture resistance of ceramics, super plasticity in ceramics: accommodation-controlling mechanisms revisited.

- *Thermal, electrical, and magnetic properties*: Thermal conductivity, electrical conduction in nanostructured ceramics, ferroelectric properties, magnetic properties of transition-metal oxides: from bulk to nano.
- 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.

3 Finite Element Modelling of Multiscale Transport Phenomena

by: V. Nassehi and M. Parvazinia
Published 2011
by Imperial College Press
57 Sheldon Street, Covent Garden, London WC2H 9HE, UK, 250pp
ISBN-13: 978-1-84816-429-1, ISBN-10: 1-84816-429-7

The main focus of this book is to provide a simple to follow account of the development of a class of practical multiscale weighted residual finite element schemes for field problems encountered in fluid flow and transport processes. In particular, dealing with the generic multiscale phenomena which affect the design and analysis of chemical engineering and polymer processing operations has been our objective.

The book starts with an explanation of the weighted residuals finite element technique to provide the necessary background for the discussions presented technique to provide the necessary background for the discussions presented later on in the book. Readers who have not previously used weighted residuals finite element schemes should, nevertheless, be able to follow the discussions presented in chapters dealing with the extension of this technique to multiscale problems. Almost all of the topics introduced in the text have been supplemented with solved examples. These examples can be used as a guide by readers to apply the constructed schemes to their own problems or they may use the described methodology for the development of multiscale schemes applicable to other problems.

Finally, we have included a detailed listing of the computer code used to solve many of the examples given in this book and provided sample input and output files. Readers can repeat the illustrated examples and gain experience for extending the programme to perform their own multiscale finite element simulations.

The book contains the following chapters:

- weighted residual finite element method
- shape functions and fundamental properties of finite elements
- basis concepts of multiscale finite element modelling
- simulation of multiscale transport phenomena in multidimensional domains
- application of multiscale finite element schemes to fluid flow problems
- computer programme.

Due to the importance of the described multiscale processes in applications such as separation processes, reaction engineering and environmental systems analysis, a sound knowledge of such methods is essential for many researchers and design engineers who wish to develop reliable solutions for industrially relevant problems.

4 3D Images o Materials Structures, Processing and Analysis

by: J. Ohsen and K. Schladitz
Published 2009
by Wiley-VCH Verlag GmbH & Co. KgaA
P.O. Box 10 11 61, 69451 Weinheim, Boschstrasse 12,
69469 Weinheim, Germany, 341pp
SBN: 978-3-527-31203-0

Taking and analysing images of materials microstructures is essential for quality control, choice and design of all kind of products. Today, the standard method still is to analyse 2D microscopy images. But, insight into the 3D geometry of the microstructure of materials and measuring its characteristics become more and more prerequisites in order to choose and design advanced materials according to desired product properties.

This first book on processing and analysis of 3D images of materials structures describes how to develop and apply efficient and versatile tools for geometric analysis and contains a detailed description of the basics of 3D image analysis.

The book contains the following chapters: Introduction; preliminaries: general notation, characteristics of sets, random sets, Fourier analysis; lattices, adjacency of lattice points and images: Introduction, point lattices, digitisation's and pixel configurations, adjacency and Euler number, the Euler number of microstructure constituents, image data, rendering; image processing: Fourier transform of an image, filtering, segmentation; measurement of intrinsic volumes and related quantities: Introduction, intrinsic volumes, intrinsic volume densities, directional analysis, distances between random sets and distance distributions; spectral analysis: Introduction, second-order characteristics of a random volume measure, correlations between random structures, second-order characteristics of random surfaces, second-order characteristics of random point fields; model-based image analysis: Introduction, motivation; macroscopically homogeneous systems of non-overlapping particles, macroscopically homogeneous systems of overlapping particles, macroscopically homogeneous fibre systems, tessellations; simulation of material properties: Introduction, effective conductivity of polycrystals by stochastic homogenisation computation of effective elastic moduli of porous media by FEM simulation.

The authors explain, some important algorithms in 2D cannot simply be generalised to 3D. Furthermore, 3D lattices pose new problems; and 3D datasets are very often huge, so that naive algorithms do not work well. This leads o the application of sophisticated methods such as Fourier method techniques, of the Euclidean distance transformation and various segmentation methods, which the authors explain in detail and apply to important practical problems. For some statisticians this may pose problems, but they recommend trying to understand these modern techniques, which are natural for physicists and experienced image analysts.

5 The Quest for Artificial Intelligence, A History of Ideas and Achievements

by: N.J. Nilsson
Published 2010
by Cambridge University Press
Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, Sao Paulo, Delhi, Dubai, Tokyo, 32 Avenue of the Americas, New York, NY 10013-2473, USA, 578pp
ISBN: 978-0-521-11639-8, ISBN: 978-0-521-12293-1

Artificial intelligence (AI) may lack an agreed-upon definition, but someone writing about its history must have some kind of definition in mind. AI is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment. According to that definition, lots of things – humans, animals, and some machines – are intelligent. Machines, such as 'smart cameras', and many animals are at the primitive end of the extended continuum along which entities with various degrees of intelligence are arrayed. At the other end are humans, who are able to reason, achieve goals, understand and generate language, perceive and respond to sensory inputs, prove mathematical theorems, play challenging games, synthesise and summarise information, create art and music, and even write histories. Because 'functioning appropriately and with foresight' requires so many different capabilities, depending on the environment, we actually have several continua of intelligences with no particularly sharp discontinuities in any of them. For these reasons, he takes a rather generous view of what constitutes AI. That means that my history of the subject will, at times, include some control engineering, some electrical engineering, some statistics, some linguistics, some logic, and some computer science.

In the book, the following parts and chapters are included:

- Part I beginnings: Dreams and dreamers, clues from philosophy and logic, life itself, engineering.
- Part II Early explorations 1950s and 1960s: Gatherings, pattern recognition, early heuristic programmes, semantic representations, natural language processing, and 1960s infrastructure.
- Part III Efflorescence: Mid-1960s to mid-1970s: computer vision, hand eye research, knowledge representation and reasoning, mobile robots, progress in natural language processing, game playing, the dendral project.
- Part IV Applications and specialisations 1970s to early 1980s: Speech recognition and understanding systems, consulting systems, understanding queries and signals, progress in computer vision.
- Part V 'New-generation' projects: The Japanese create a stir, DARPA's strategic computing programme.
- Part VI Entr'acte: Speed bumps, controversies and alternative paradigms.
- Part VII The growing armamentarium, from the 1980s onward: Reasoning and representation, other approaches to reasoning and representation, Bayesian networks,

machine learning, natural languages and natural scenes, intelligent system architectures.

- Part VIII Modern AI today and tomorrow: extraordinary achievements, ubiquitous AI, smart tools, the quest continues.

6 Materials Research Society, Symposium Proceedings Volume 1242, Materials Characterisation, Symposium held August 16–21, Cancun, Mexico

by: R.P. Campos, A.C. Cuevas and R.A.E. Muńoz
Published 2010
by Materials Research Society
Warrendale, Pennsylvania, 506 Keystone Drive,
Warrendale, PA 15086, 242pp
CODEN: MRSPDH

The XVIII International Materials Research Congress 2009 was held in Cancun, Mexico from August 16–21, 2009. It was organised by The Mexican Materials Research Society. About 1,600 specialised scientists from more than 30 countries participated in the 21 different symposia.

This Materials Research Society Proceedings contains papers contributed to Symposium 4, 'Materials Characterisation'. This event was intended as a forum for the dissemination of research results on materials science, and also provided an excellent opportunity for materials scientists around the world to have a common platform to exchange their findings and to discuss developments and start collaborating at the national and international level.

The symposium programme included 65 oral and 158 poster presentations. In addition, invited talks were focused on different topics such as composites, alloys, electron microscopy and corrosion prevention applications. This volume contains 33 papers that were selected after peer review and were recommended for publication in this special issue.

Some important topics addressed at the conference were the analytical techniques focused on the microstructural, chemical, optical, electronic, magnetic and mechanical properties of materials. These included metals, alloys, ceramics, steels, composites, concrete, nanomaterials, and surface coatings, among others. Structural characterisation techniques included scanning electron microscopy, X-ray diffraction, transmission electron microscopy, atomic force microscopy, light optical microscopy, atomic absorption, luminescence, thermo luminescence, energy transfer, photorefractive effect, photo catalysis, photoconductivity and laser emission. Theoretical models developed from these properties are also feature.