
Book Reviews

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1 Current Topics in Elastomers Research

by: A.K. Bhowmick

Published 2008

by CRC Press, Taylor & Francis Group

6000 Broken Sound Parkway NW, Suite 300,

Boca Raton, FL 33487-2742, USA, 1104pp

ISBN-13: 978-0-8493-7317-6, ISBN-10: 0-8493-7317-4

From weather-proof tyres and artificial hearts to the o-rings and valve seals that enable successful space exploration, rubber is an indispensable component of modern civilisation. Stiff competition and stringent application requirements foster continuous challenges and materials manufacturers fund ever-expanding research projects to surpass them. However, this vast and growing body of knowledge is jealously guarded by the rubber companies and not published in the open literature, leaving the novice or general researcher forced, as it were, to re-invent the wheel.

Providing the first comprehensive overview of rubber research activities from around the world, current topics in elastomers research:

- Introduces the chemistry and structure-property relationships of a variety of new materials and composites.
- Presents current research activities on new rubbers, thermoplastic elastomers, nanocomposites, biomaterials, and smart polymers, as well as rubber blends, composites, and rubber ingredients.
- Evaluates 3D-TEM and AFM, two important new characterisation techniques.
- Considers physics and engineering topics, including reinforcement mechanisms; viscoelasticity; abrasion, fatigues, adhesion; rheology, mixing, and processing; and the effects of time, temperature, and fluids.
- Predicts future trends, including recycling and green materials.
- Discusses the tyre, a driving impetus for research and one of the major applications of rubber.
- Provides a guide for selecting the most appropriate and recent rubbers and composites for specific applications.
- Offers solutions to many practical problems.

In the book, the following chapters are included:

- Introductory chapter: Some outstanding problems in the mechanics of rubbery solids.
- New elastomers and composites: elastomer-clay nanocomposites, rubber-silica hybrid nanocomposites, rubber nanocomposites based on miscellaneous nanofillers, thermoplastic elastomers, plastomers, new elastomers: biomacromolecular engineering via carbocationic polymerisation, novel elastomers for biomedical application, recombinant resilin-a protein-based elastomer, smart elastomers, recent developments in rubber-rubber and rubber-plastics blends, fibre-reinforced elastomers, a chemical modification approach for improving the oil resistance of ethylene-propylene copolymers.
- Rubber ingredients: rubber-curing systems, degradation and protection, Q-flex QDI Quinone Diimine antidegradant-improved mixing chemistry resulting in a better balance of productivity and performance, silica fillers for elastomer reinforcement, mechanism of the carbon black reinforcement of rubbers.
- New characterisation techniques: visualisation of nano-filler dispersion and morphology in rubbery matrix by 3D-TEM, scanning probe microscopy of elastomers and rubbery materials, recent developments in rubber research using atomic force microscopy.
- Physics and engineering: reinforced elastomers: from molecular physics to industrial applications, effects of time, temperature, and fluids on the long-term service durability of elastomers and elastomeric components, extrapolating the viscoelastic response of rubber, recent advances in fatigue life prediction methods for rubber components, rubber friction and abrasion in relation to tyre traction and wear, Improving adhesion of rubber, rheology of rubber and rubber nanocomposites, runner-silica mixing, stream effects and non-linear viscoelasticity in rubber processing operations, electron beam processing of rubber.
- Tyres: tyre technology-recent advances and future trends, recent developments in fillers for tyre applications, rubber oxidation in tyres, recent developments in rubber mixing and cord calendaring in tyre production, high-tech quadroplex extrusion technology for the tyre industry.
- Eco-friendly technology and recycling: recent advances in eco-friendly elastomer technology waste rubber recycling.

Barring the inaccessibility of truly classified information, current topics in elastomers research is a complete review of the current state-of-the-science of elastomers research and applications, compiling once-guarded knowledge and outlining the future directions of the field.

2 Rubber Technologist's Handbook, Volume 2**by: J. White, S.K. De and K. Naskar****Published 2009****by Smithers – A Smithers Group Company****Shawbury, Shrewsbury, Shropshire, SY4 4NR, UK, 452pp****ISBN: 978-1-84735-100-5 (hardback), ISBN: 978-1-84735-099 (softback)**

This book is a companion volume to Rubber Technologist's Handbook published in 2001. Written by experts in their respective fields, this handbook discusses the most recent developments in the subject.

The ten chapters cover microscopic imaging of rubber compounds, intelligent tyres, silica-filled rubber compounds, fibres in the rubber industry, naval and space applications of rubber, advances in fillers for the rubber industry, thermoplastic elastomers by dynamic vulcanisation, polymers in cable applications, durability of rubber compounds, and radiochemical ageing of ethylene-propylene-diene monomer.

In the book, the following chapters are included: microscopic imaging of rubber compounds, intelligent tyres, silica-filled rubber compounds, fibres in the rubber industry, naval and space applications of rubber, advances in fillers for the rubber industry, thermoplastic elastomers by dynamic vulcanisation, polymers in cable application, durability of rubber compounds, radiochemical ageing of ethylene-propylene-diene monomer elastomers, Silicon rubber.

This book will serve the needs of those who are already in the rubber industry and new entrants to the field who aspire to build a career in rubber and allied areas. Materials science students and researchers, designers and engineers should all find this handbook helpful.

3 Magnesium, 8th International Conference on Magnesium Alloys and their Applications**by: F.K.U. Kainer****Published 2009****by Wiley-VCH Verlag GmbH & Co.****KgaA, P.O. Box 10 11 61, 69451 Weinheim, Boschstrasse 12,****69469 Weinheim, Germany, 1454pp****ISBN: 978-3-527-32732-4, ISBN: 978-3-527-32732-4**

In a time where sustainability and energy efficiency are the priorities when designing new products, the need for more flexible raw materials becomes even more evident. Magnesium alloys offer extremely favourable mechanical properties and high recyclability, making it one of the most promising light-weight materials for wide-spread use in the transportations and consumer industries. By selective alloy modification or combining it with other materials, its properties can be tailored to fit the desired characteristics such as increased strength, improved creep resistance, acceptable corrosion behaviour, increased wear resistance and durability. In addition, novel processing methods like semi-solid casting have drastically increased the application range of magnesium alloy components.

This book brings together the most recent findings in the science and technology of magnesium and its alloys. The contributions range from the development of novel alloys to the experimental and theoretical characterisation of their properties, from classic to advanced casting methods such as rheocasting and thixoforming, and from post-processing of magnesium alloy components to their use on the industrial scale.

For more than 15 years, increasing activities in research and applications have been observed all over the world. This led to the development of new alloys and their use in interior, structure and the power train of automobiles. Moreover, magnesium wrought alloys are finding more applications in 3C industries. New alloys and optimised processes are also creating new ideas and stimulating competition for advanced developments to substitute traditional materials. The implementation of new cast alloys and the increased use of wrought alloys are clear indications for the sustainable research and development of the past.

4 A Practical Guide to Scientific Data Analysis

by: D. Livingstone

Published 2009

by John Wiley & Sons, Ltd.

The Atrium, Southern Gate, Chichester, West Sussex,

P.O. 19 8SQ, UK, 341pp

ISBN: 978-0-470-851531

This handbook of data analysis with worked examples focuses on the application of mathematical and statistical techniques and the interpretation of their results.

Covering the most common statistical methods for examining and exploring relationships in data, the text includes extensive examples from a variety of scientific disciplines.

The chapters are organised logically, from planning an experiment, through examining and displaying the data, to constructing quantitative models. Each chapter is intended to stand alone so that casual users can refer to the section that is most appropriate to their problem.

Written by a highly qualified and internationally respected author this text is of practical use to chemists, biochemists, pharmacists, biologists and researchers from many other scientific disciplines in both industry and academia:

- presents statistics for the non-statistician
- explains a variety of methods to extract information from data
- describes the application of statistical methods to the design of 'performance chemicals'
- emphasises the application of statistical techniques and the interpretation of their results.

In the book, the following chapters are included:

- introduction: data and its properties, analytical methods and jargon
- experimental design-experiment and set selection

- data pre-treatment and variable selection
- data display
- unsupervised learning
- regression analysis
- supervised learning
- multivariate dependent data
- artificial intelligence and friends
- molecular design.

There are also many other areas of science which can benefit from the application of statistical and mathematical methods to an examination of their data, particularly multivariate techniques. I hope that scientists from these other disciplines will be able to see how such approaches can be of use in their own work.

5 Mechanical Properties and Performance of Engineering Ceramics and Composites IV, a Collection of Papers Presented at the 33rd International Conference on Advanced Ceramics and Composites, January 18–23, 2009, Daytona Beach, Florida
by: D. Singh and W.M. Kriven
Published 2010
by The American Ceramic Society, by John Wiley & Sons, Inc. Hoboken, New Jersey, And Scrivener Publishing, LLC, Salem, Massachusetts, 336pp
ISBN: 978-0-470-45752-8

This volume is a compilation of papers presented in the Mechanical Behaviour and Performance of Ceramics and Composites and Geopolymers and other Inorganic Polymers Symposia during the 33rd International Conference and Exposition.

The theme of international participation continued at the 33rd International Conference on Advanced Ceramics and Composites (ICACC), with over 1,000 attendees from 39 countries.

The Mechanical Behaviour and Performance of Ceramics and Composites Symposium addressed the cutting-edge topics on mechanical properties and reliability of ceramics and composites and their correlations to processing, microstructure, and environmental effects. The symposium included over 100 presentations representing ten countries. Symposium topics included:

- ceramics and composites for engine applications
- design and life prediction methodologies
- environmental effects on mechanical properties
- mechanical behaviour of porous ceramics
- reliability of small-scale systems

- ultra high temperature ceramics
- ternary compounds
- mechanics and characterisation of nanomaterials and devices
- novel test methods and equipment
- processing-microstructure-mechanical properties correlations
- ceramics and composites joining and testing
- NDE of ceramic components.

This meeting also marked the seventh meeting on geopolymers within and ACerS sponsored conference. This years focused session on Geopolymers included 22 speakers. While the session provided a lively forum for discussion, the resulting seven papers are published in this issue.

6 Polymer Melt Processing, Foundations in Fluid Mechanics and Heat Transfer

by: M.M. Denn

Published 2008

by Cambridge University Press

32 Avenue of the Americas, New York, NY 10013-2473, USA, 264pp

ISBN: 978-0-521-89969-7 (hardback)

Most of the shaping in the manufacture of polymeric objects is carried out in the melt state, as is a substantial part of the physical property development. Melt processing involves an interplay between fluid mechanics and heat transfer in rheologically complex liquids, and taken as a whole it is a nice example of the importance of coupled transport processes.

The book begins with introductory material and a brief review of fundamentals, after which the first part focuses on analytical treatments of basic polymer processes: extrusion, mould filling, fibre spinning, and so forth. The thin gap (lubrication) and thin filament approximations are employed, and all analyses in this part are for inelastic liquids. An introduction to finite element calculation follows, where full numerical solutions are compared to analytical results. Polymer rheology is then introduced, with an emphasis on relatively simple viscoelastic models that have been used with some success to model processing operations. Applications in which melt viscoelasticity is important are then revisited, followed by a chapter on stability and sensitivity that focuses on melt spinning and a chapter on wall slip and extrusion instabilities. There are brief concluding chapters on structured fluids and mixing and dispersion.

The following chapters are included in the book:

- polymer processing
- fundamentals
- extrusion
- temperature and pressure effects in flow

- the thin gap approximation
- quasi-steady analysis of mould filling
- fibre spinning
- numerical simulation
- polymer melt rheology
- visco elasticity in processing flows
- stability and sensitivity
- wall slip and extrusion instabilities
- structured fluids
- mixing and dispersion.

This is a book about the underlying foundations of polymer melt processing, which can be derived from relatively straightforward ideas in fluid mechanics and heat transfer; the level is that of an advanced undergraduate or beginning graduate course, and the material can serve as the text for a course in polymer processing or for a second course in transport processes.

The only background necessary is some prior study of the fundamentals of fluid flow and heat transfer and a command of mathematics at a level typically expected of an advanced undergraduate student in engineering or the physical sciences; the text is otherwise self-contained.

7 Structural Ceramics, Fundamentals and Case Studies

by: F.L. Riley

Published 2009

by Cambridge University Press

The Edinburgh Building, Cambridge CB2 8 RU, UK, 418pp

ISBN: 978-0-521-84586-1 (hardback)

The technical ceramics can be divided into electroceramics, which, by and large, make use of the materials electrical or magnetic properties, and the structural ceramics, with applications mainly (though not entirely) dependent on mechanical properties. The structural ceramics providing the case studies for this book have been chosen because they illustrate well the characteristic features of the class of structural ceramics as a whole. They have a wide range of properties, and they are of considerable technical importance.

Each of the materials is examined systematically to provide an outline of its history and a simple picture of its development, how it can be fabricated, details of key physical and mechanical properties, and a summary of the principal applications based on these properties.

In the book, the following chapters are included:

- Fundamentals: what are structural ceramics, compositions, microstructure, powders, sintering, mechanical and physical properties, the structural ceramic portfolio, and materials selection.
- Porcelain: description and history, general features of porcelain, compositions and production methods, physical aspects of porcelain production, microstructure, physical and mechanical properties, and technical applications.
- Alumina: description and history, intrinsic properties of α -aluminium oxide, ceramic production, microstructures, physical and mechanical properties, chemical properties, and applications.
- Silicon carbide: description and history, basic aspects, physical and mechanical properties, the development of silicon carbide ceramics, ceramic materials, applications.
- Silicon nitride: description and history, basic aspects, intrinsic physical and mechanical properties, introduction to the development of silicon nitride ceramics, ceramic materials, sialons, and applications.
- Zirconia: description and history, powder production, crystal chemistry, phase equilibrium diagrams, phase stabilisation, mechanical properties, other physical and mechanical properties of zirconium dioxide, and ceramic materials.
- Conclusions: the materials, history, current application areas, the market-place, and ceramic composites.

Over 200 diagrams and photographs provide visual aids to learning, and end-of-chapter summaries pull together key points. With numerous review questions to test understanding of the topics covered, and extensive referencing, this book is ideal for those studying materials science and engineering, or starting research in the structural ceramics area.

8 Quick finite Elements for Electromagnetic Waves

by: G. Pelosi, R. Coccioli and S. Selleri

Published 2009

by ARTEC house, Inc.

685 Canton Street, Norwood, MA 02062, 289pp

ISBN-13: 978-1-59693-345-3

The implementation of finite element methods is not simple though. In comparison to other popular numerical techniques, most notably the finite difference method, it requires a finer analytical development of the formulation before going to the implementation, a deeper knowledge of linear algebra methods, as well as a more involved preprocessing phase. Probably for these reasons, the usage and full knowledge of FEM is still limited to a relatively small number of researchers and microwave engineers despite its enormous possibilities and versatility.

Textbooks on finite element methods are still few in number, even if new ones are published constantly, and the method still lacks a full citizenship in university courses, both at undergraduate and graduate levels. Most of the books on finite elements cover the

theory behind the method, rarely providing the reader with codes to experiment with, even very simple ones indeed. This implies that, after having studied the book, the reader needs some time to develop his first working FEM code and, most often this time is too long with respect to that allocated to finite elements in university courses on numerical methods, or available to practitioners. Consequently, it is very difficult for those approaching the method for the first time to fully appreciate its power without quickly getting some numerical results from an FEM code.

The CD-ROM bounded to *Quick FEM* contains the complete software described in the text and uses the practical, implementation-oriented attitude of the book. The source codes have been written in FORTRAN 77 and are designed to be as platform independent as possible.

This book has been organised so that each reader can hopefully benefit the most in the shortest possible time by choosing the chapters to read on the basis of his or her own interests and knowledge.

The book is divided into three parts. The first devoted to two-dimensional problems, the second dealing with three-dimensional problems, the last containing a bibliography referencing key papers and books on finite elements.

Part I Two dimensions

- getting started
- tools
- microwave guiding structures-characterisation
- microwave guiding structures:
- scattering and antennas-hybrid methods
- scattering and antennas-absorbing boundary conditions

Part II Three dimensions

- finite elements in three dimensions
- resonant cavities
- waveguide devices

Part III To probe further.

The classic 1998 Artech House book, *Quick finite elements for electromagnetic waves*, has now been revised and expanded to bring professionals up-to-date with the latest developments in the field. Engineers will find brand-new discussions on finite elements in 3D, 3D resonant cavities, and 3D waveguide devices. Moreover, the second edition supplies engineers with MATLAB code, making this resource easier to comprehend and use for varied projects in the field.