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## Book Reviews

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### **1 A Concise Introduction to Additives for Thermoplastic Polymers**

**by: J.K. Fink**

**Published 2010**

**by John Wiley & Sons, Inc., Hoboken, New Jersey,  
and Scrivener Publishing, LLC, Salem, Massachusetts, 268pp**

**ISBN: 978-0-470-60955-2**

A Concise Introduction to Additives for Thermoplastic Polymers focuses on additives for thermoplastic polymers and describes 21 of the most important and commonly used additives from plasticisers and fillers to optical brighteners and anti-microbial additives. It also includes chapters on safety and hazards, and prediction of service time models.

While there are many exhaustive and complex books dealing with additives for polymers, the size of them deter students and many industry engineers from using them. The purpose of this book, therefore, is to fill this void and present a concise introduction to this important subject.

Written in an accessible and practical style, the author introduces the reader to the complex subject of plastics additives in an engaging manner. His ability to be concise is the result of his teaching courses on the subject and using his own lecture notes for material. This book comprises the author's course notes so that a larger public can benefit from his knowledge.

In the book the following chapters are included:

Introduction, Plasticisers, Fillers, Colorants, Optical Brighteners, Antimicrobial Additives, Flame Retardants, Lubricants, Antistatic Additives, Slip Agents, Surface Improvers, Nucleating Agents, Antifogging Additives, Antiblocking Additives, Hydrolysis, Dehydrochlorination Stabilisers, Acid Scavengers, Metal Deactivators, Oxidative Degradation, Degradation by Light, Blowing Agents, Compatibilisers, Prediction of Service Time and Safety and hazards.

A Concise Introduction to Additives for Thermoplastic Polymers is the ideal primer for students who will later work in polymer science or the development of plastics formulation, as well as industry engineers and specialists who want to have a deeper knowledge of the plastics industry.

Beyond education, this book will serve the needs of industry engineers and specialists who have only a passing contact with the plastics industry but need to know more.

## 2 Viscoelastic Materials

by: **R. Lakes**

Published **2009**

by **Cambridge University Press, 32 Avenue of the Americas,**

**New York, NY 10013-2473, USA, 480pp**

**ISBN 978-0-521-88568-3 (hardback)**

A development of the theory is presented, including both transient and dynamic aspects, with emphasis on linear viscoelasticity. The structure of the theory is presented with the aim of developing physical insight. Methods for the solution of stress analysis problems in viscoelastic objects are developed and illustrated. Experimental methods for characterisation of viscoelastic materials are explored in detail. Viscoelastic phenomena are described for a wide variety of materials, including polymers, metals, ceramics, geological materials, biological materials, synthetic composites, and cellular solids. High-damping alloys and composites are considered as well as materials that resist creep. To illustrate the sources of viscoelastic phenomena, we describe and analyse causal mechanisms, with cases of materials of extremely high damping and extremely low damping. The theory of viscoelastic composite materials is presented, with examples of various types of structures and the relationships between structure and mechanical properties. Many applications of viscoelasticity and viscoelastic materials are illustrated, with case studies and analysis of particular cases. Viscoelasticity is pertinent to applications as diverse as earplugs, gaskets, computer disks, satellite stability, medical diagnosis, injury prevention, vibration abatement, tyre performance, sports, spacecraft, and music.

This book contains the following chapters:

- *Introduction: Phenomena:* viscoelastic phenomena, motivations for studying viscoelasticity transient properties: creep and relaxation, dynamic response to sinusoidal load, demonstration of viscoelastic behaviour, historical aspects.
- *Constitutive relations:* introduction, prediction of the response of linearly viscoelastic materials, restrictions on the viscoelastic functions, relation between creep and relaxation, stress vs. strain for constant strain rate, particular creep and relaxation functions, effect of temperature, three-dimensional linear constitutive equation, aging materials, dielectric and other forms of relaxation, adaptive and smart materials, effect of nonlinearity.
- *Dynamic behaviour:* introduction and rationale, the linear dynamic response functions, Kramers–Kronig relations, energy storage and dissipation, resonance of structural members, decay of resonant vibration, wave propagation and attenuation, measures of damping, nonlinear materials.
- *Conceptual structure of linear viscoelasticity:* introduction, spectra in linear viscoelasticity, approximate interrelations of viscoelastic functions, conceptual organisation of the viscoelastic functions.
- *Viscoelastic stress and deformation analysis:* introduction, three-dimensional constitutive equation, pure bending by direct construction, correspondence principle, pure bending by correspondence, correspondence principle in three dimensions,

Poisson's ratio, dynamic problems: effects of inertia, non correspondence problems, bending in nonlinear viscoelasticity.

- *Experimental methods*: introduction and general requirements, creep, inference of moduli, displacement and strain measurement, force measurement, load application, environmental control, subresonant dynamic methods, resonance methods, achieving a wide range of time or frequency, test instruments for viscoelasticity, wave methods.
- *Viscoelastic properties of materials*: introduction, polymers, metals, ceramics, biological composite materials, common aspects.
- *Causal mechanisms*: introduction, thermo elastic relaxation, relaxation by stress-induced fluid motion, relaxation by molecular rearrangement, relaxation by interface motion, relaxation processes in crystalline materials, magnetic and piezoelectric materials, non exponential relaxation, concepts for material design, relaxation at very long times.
- *Viscoelastic composite materials*: introduction, composite structures and properties, prediction of elastic and viscoelastic properties, bounds on the viscoelastic properties, extremal composites, biological composite materials, poisson's ratio of viscoelastic composites, particulate and fibrous composite materials, cellular solids, piezoelectric composites, dispersion of waves in composites.
- *Applications and case studies*: introduction, a viscoelastic earplug: use of recovery, creep and relaxation of materials and structures, creep and recovery in human tissue, creep damage and creep rupture, vibration control and waves, smart materials and structures, rolling friction, uses of low-loss materials, impulses, rebound and impact absorption, rebound of a ball, applications of soft materials, applications involving thermoviscoelasticity, satellite dynamics and stability.

*Appendix*: mathematical preliminaries, transforms, Laplace transform properties, convolutions, interrelations in elasticity theory, other works on viscoelasticity.

This book is intended to be used in a one-semester graduate course on the properties, analysis, and uses of viscoelastic materials. A precursor book, *Viscoelastic solids*, has been used as a text in such a course. This book contains many updates, expanded coverage of the materials science of the causes of viscoelastic behaviour, and of the properties of materials of biological origin, and applications of viscoelastic materials. The objective is to make the subject accessible and useful to students in a variety of disciplines in engineering and physical science. To that end, the coverage is intentionally broad. For research scientists and engineers or graduate students who pursue the subject via self-study, many references have been included to provide links to the literature. The subject may be profitably studied by undergraduate students, particularly those who are interested in vibration abatement, biomechanics, and the study of materials. Most of the book should be accessible to people who have completed an intermediate or an elementary course on the mechanics of deformable bodies. Exposure to elasticity theory, materials course on the mechanics of deformable bodies. Exposure to elasticity theory, materials science, and vibration theory is helpful but not necessary.

### 3 Characterisation of Polymers, Volume 2

by: **T.R. Crompton**

**Published 2009**

**by Smithers Rapra Technology Limited, Shawbury,  
Shrewsbury, Shropshire, SY4 4NR, UK, 529 pp**

**ISBN: 978-1-84735-126-5, ISBN: 978-1-84735-125-8**

This book is the second part of a two volume compendium of the types of methodology that are used for the determination of the chemical composition of polymers.

Volume 2 covers the methodology used for determining the structure and microstructure of polymers, copolymers and rubbers. This volume also gives a more detailed analysis of sequencing of monomer units in copolymers, end-group analysis, tacticity and stereochemical determinations.

This volume gives an up-to-date and thorough exposition of the state-of-the-art theories and availability of instrumentation needed to effect chemical and physical analysis of polymers. This is supported by approximately 1200 references.

In the book, the following chapters are included:

- Pyrolysis – gas chromatography: Discussion of technique and equipment, Applications, homopolymers, Copolymer applications.
- Complementary pyrolysis-gas chromatography-FT-IR: Theory, Instrumentation, Applications.
- Complementary pyrolysis-mass spectrometry: Applications.
- Complementary pyrolysis gas chromatography-mass spectrometry: Homopolymers, Copolymers.
- Reaction gas chromatography techniques: Hydrolyssis gas chromatography, Alkali fusion, Simultaneous pyrolysis derivatisation, Prepyrolysis derivatistion.
- Sequencing of homopolymers: Sequencing in polyethylene, polypropylene, Polyisoprene, Polystyrene, Polybutadiene, Polyurethanes.
- Sequencing in copolymers: Olefinic copolymers, Styrene copolymers, Vinyl acetate copolymers, Acrylonitrile and methacrylonitrile containing copolymers, Acylate and methacrylate copolymers, Vinyl chloride-vinylidene chloride, Ethylene oxide containing copolymers.
- Stereoisomerism and tacticity: Tacticity of polypropylene, Syndiotactic polystyrene, Polyvinylchloride.
- Regioisomerism: Polypropylene homopolymer, Polypropylene-1-ethylene copolymer, Polybutadiene-1-ethylene copolymer, Polybutadiene-1-ethylene copolymer, Polybutadiene.
- Branching: Branching in polyethylene, Olefin copolymers.
- Block copolymers.

- Types of unsaturation: Unsaturation in homopolymers, Unsaturation in Copolymers, Ozonolysis techniques.
- Determination of end-groups: Polypropylene oxide, Polystyrene, Polyethylene, Polyethylene terephthalate, Polyisobutylene.

#### **4 Polymer Electronics – A Flexible Technology**

**by: F. Gardiner and E. Carter**

**Published 2009**

**by Smithers – A Smithers Group company, Shawbury, Shrewsbury, Shropshire, SY4 4NR, United Kingdom, 142pp**

**ISBN: 978-1-84735-421-1, ISBN: 978-1-84735-422-8,**

**ISBN: 978-1-84735-423-5**

The rapid development of polymer electronics has revealed the possibility for transforming the electronics market by offering lighter, flexible and more cost effective alternatives to conventional materials and products. With applications ranging from printed, flexible conductors and novel semiconductor components to intelligent labels, large area displays and solar panels, products that were previously unimaginable are now beginning to be commercialised.

This new book on Polymer Electronics is designed to inform researchers, material suppliers, component fabricators and electronics manufacturers of the latest research and developments in this dynamic and rapidly evolving field.

With a prestigious group of authors writing on a wide range of polymer electronics and related technology topics, this book brings together the technologies and applications at the heart of polymer electronics.

This book details current and future developments in the fast-moving polymer electronics industry.

This book will be of interest to those involved in the following sectors: photovoltaics and solar energy, displays, intelligent packaging, smart labels, medical electronics, electronic manufacturing, defence and aerospace, and sensors and transducers.

The book contains the following chapters:

- roadmap for organic and printed electronics
- technical issues in printed electrodes for all-printed thin-film transistor applications
- all-printed flexible organic light-emitting diodes
- roadmap for organic and printed electronics
- highly conductive plastics-custom-formulated functional materials for injection mouldable electronic applications
- additives in polymer electronics
- a facile route to organic nanocomposite dispersions of polyaniline-single wall carbon nanotubes
- preparation and characterisation of novel electrical conductive rubber blends

- solar textiles
- flexible sensor array for a robotic fingertip using organic thin film transistors with minimum interconnects and improved noise tolerance
- an organic thin film transistor pixel circuit for active-matrix organic light
- intelligent packaging for the food industry.

## **5 An Introduction to Modeling and Simulation of Particulate Flows**

**by: T.I. Zohdi**

**Published 2007**

**by SIAM Society for Industrial and Applied Mathematics,**

**3600 Market Street, 6th Floor, Philadelphia,**

**PA 19104-2688, USA, 176pp**

**ISBN: 987-0-898716-27-6**

Recently, several modern applications, primarily driven by microtechnology, have emerged where a successful analysis requires the simulation of flowing particulate media involving simultaneous near-field interaction between charged particles and momentum exchange through mechanical contact. For example, in many systems containing flowing particles below the 1 mm scale, the particles can acquire relatively large electrostatic charges, leading to significant interparticle near-field forces. In some cases, the near-field forces could be due to magnetic effects, or they could be purposely induced. Charged material can lead to inconsistent 'clean' manufacturing processes, for example, due to difficulties with dust control, although intentional charging of particulate material can be quite useful in some applications, for example, in electrostatic copiers, inkjet printers, and powder coating machines. The presence of near-field interaction forces can reduce particulate flows that are significantly different from purely contact-driven scenarios. Determining the dynamics of such materials is important in accurately describing the flow of powders, which form the basis of microfabrication. Near-field forces can lead to particle clustering, resulting in inconsistent fabrication of the characteristics of such flows. Thus, an issue of overriding importance to the successful characterisation of such flows is the development of models and reliable computational techniques to simulate the dynamics of multibody particulate systems involving near-field interaction and contact simultaneously, including thermal effects.

The book presents chapters titled:

- *Fundamentals*: Notation, Kinematics of a single particle, Kinetics of a single particle, Systems of particles.
- *Modelling of particulate flows*: Particulate flow in the presence of near-fields, Mechanical contact with near-field interaction, Kinetic energy dissipation, Incorporating friction;
- *Iterative solution schemes*: Simple temporal discretisation, An example of stability limitations, Application to particulate flows, Algorithmic implementation.
- *Representative numerical simulations*: Simulation parameters, Results and observations.

- *Inverse problems/parameter identification*: a genetic algorithm, a representative example.
- *Extensions to 'swarm-like' systems*: Basic constructions, A model objective function, Numerical simulation, Discussion.
- *Advanced particulate flow models*: Introduction, Clustering and agglomeration via binding forces, Long-range instabilities and interaction truncation, A simple model for thermochemical coupling, Staggering schemes.
- *Coupled particle/fluid interaction*: A model problem, Numerical discretisation of the Navier–Stokes equations, Numerical discretisation of the particle equations, An adaptive staggering solution scheme, a numerical example, Discussion of the results, Summary.
- *Simple optical scattering methods for particulate media*: Introduction, Plane harmonic electromagnetic waves, Multiple scatterers, Discussion, Thermal coupling, Solution procedure, Inverse problems parameter identification, Parametrisation and a genetic algorithm, Summary.
- *Closing remarks*: Basic (continuum) fluid mechanics, Scattering.

This work can be viewed as a research monograph, suitable for use in a first-year graduate course for students in the applied sciences, engineering, and applied mathematics with an interest in the computational analysis of complex particulate flows.

## **6 High Energy Density Lithium Batteries, Materials, Engineering, Applications**

**by: K.E. Aifantis, S.A. Hackney and R.V. Kumar**

**Published 2010**

**by Wiley-VCH Verlag GmbH & Co. KGaA, P. O. Box 10 11 61,  
69451 Weinheim, Boschstrasse 12, 69469 Weinheim, Germany, 282 pp  
ISBN: 978-3-527-32407-1**

It is this need for high density energy storage devices that prompted us to edit the present book. Although batteries are essential to everyone from a very young age, their explicit study is not custom during college education. The present book, therefore, start out with an introductory chapter that familiarises the reader with the basic electrochemical processes and properties of batteries. In continuing, Chapters 2 and 3 give a historic outline of the development of primary and secondary (rechargeable) batteries, where the highly preferred properties of Li batteries are illustrated. To further motivate the reader about the importance of continuous research on secondary Li chemistries, Chapter 4 describes the current and potential application of Li batteries, focusing on how they can be used for powering electric vehicles. The remaining chapters, therefore, elaborate on technological developments that are currently being undertaken for improving cathodes, anodes and electrolytes for rechargeable Li batteries; the common characteristic of all these components is their nanoscale structure. This book is, therefore, appropriate not only for advanced undergraduates and graduates, but also for battery developers (Chapters 4–8). Chapter 8 in particular is a collection of recent studies that are concerned

with the limited theoretical works of the last decade that try to predict, using mechanics, the optimum materials chemistries for next generation anodes and cathodes. Such theoretical considerations, must be accounted for, in order to develop next-generation electrodes, as experiments and theory go hand in hand for obtaining the most efficient product.

The book presents chapters titled:

- Introduction to Electrochemical Cells
- Primary Batteries
- A Review of Materials and Chemistry for Secondary Batteries
- Current and Potential Applications of Secondary Li Batteries
- Li-Ion Cathodes: Materials Engineering through Chemistry
- Next-Generation Anodes for Secondary Li-Ion Batteries
- Next-Generation Electrolytes for Li Batteries
- Mechanics of Materials for Li-Battery Systems.