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## **Book Reviews**

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**Reviewed by Janez Grum**

E-mail: janez.grum@fs.uni-lj.si

### **1 Wear Analysis for Engineers**

**by: R.G. Bayer**

**Published 2002**

**by HBN Publishing**

**250W. 78th St., #3FF, New York, NY 10024, USA, 360pp**

**ISBN: 0-9664286-5-X**

Like other types of analysis commonly used in engineering, wear analysis is fundamentally the use of equations and models to evaluate wear behaviour. However, for it to be effective, wear analysis must incorporate certain elements and considerations beyond the evaluation of equations. In this book, I describe a wear analysis methodology that incorporates these elements and considerations. While wear behaviour is complex, useful wear analyses often are not. Generally, the complexity and rigor of the analysis depend primarily on the engineering needs and secondarily on the wear situation. It has been my experience that simple and basic wear analyses, conducted in the proper manner, are often adequate in many engineering situations. Integral and fundamental to the wear analysis approach is the treatment of wear and wear behaviour as a system property. As a consequence, wear analysis is not limited to the evaluation of the effects of materials on wear behaviour. Wear analysis often enables the identification of non-material solutions or non-material elements in a solution to wear problems. For example, changes in or recommendations for contact geometry, roughness, tolerance, and so on are often the results of a wear analysis.

The book contains the following chapters:

- The wear analysis method: Wear analysis overview, the wear analysis process, process implementation.
- Basic tribology: System concept, wear mechanisms, friction, lubrication, wear situations, design factors.
- Examination methods: Tribosystems, wear, operating and design conditions, supplementary examinations and comparisons.
- Characterisation methods: Operational classification, mechanistic classification.
- Phenomenological considerations: Tribological trends, pivotal features, lubrication, materials, database use and testing, wear severity.
- Analytical methods: Wear relationships, data analysis, alternative models.

- Special considerations: Contact conditions, fluid lubrication, coatings and surface treatments, journal bearings, fretting, galling.
- Wear analysis examples: Design triage for sliding wear, electro-erosion print head, fluid transfer system lugs, injection valve, disk drive bearing.
- Appendixes: Equations for contact stress and area, nominal k-factors and friction coefficients, zero-wear factors and coefficients of friction for sliding, K-factors and P-V limits for plastics, galling threshold stress.

The wear analysis method is developed using numerous equations and is illustrated with more than 130 figures (including more than 80 micrographs). Its implementation is demonstrated with several detailed case studies and extensive compilations of wear data in dozens of tables and five appendixes. For situations where more detailed information is required, the discussion is supplemented with 220 references.

The book is an invaluable resource for practicing design and mechanical engineers, university-level courses in mechanical and materials engineering, tribologists, reliability engineers, and failure analysis engineers.

## **2 Polymer Nanocomposites Handbook**

**by: R.K. Gupta, E. Kennel and K.J. Kim**

**Published 2010**

**by CRC Press**

**Taylor & Francis Group, 6000 Broken Sound Parkway NW,  
Suite 300, Boca Raton, FL 33487-2742, USA, 552pp**

**ISBN: 978-0-8493-9777-6**

Reflecting the exceptional growth in the use of nanostructured materials for an increasing range of industrial applications, *Polymer Nanocomposites Handbook* comprehensively covers the synthesis of nanomaterials that act as the building blocks of polymer nanocomposites and polymers that act as matrix materials.

From early history to new technologies, the book guides readers through the development of nanocomposites and their broad and rapidly developing applications from flame retardant properties to advances in polymer compounding. Using examples from today's leading academic and industrial research labs, top scientists provide in-depth discussions of the science, processing, and technology that have accompanied nanocomposites' ascension into the world of chemical and materials science.

Features:

- covers the synthesis of nanomaterials that act as building blocks of PNCs and polymers that act as matrix materials
- reviews atomic scale and large structures of the nanoscale building blocks and their interfaces
- describes current processing and the difficulties of obtaining good dispersion.

With 19 chapters authored by world leaders in nanocomposite research, this handbook provides diverse and authoritative coverage on the scientific underpinnings and revolutionary discoveries related to this promising field.

### **3 Nano- and Biocomposites**

**by: A. Kin-Tak Lau, F. Hussain and K. Lafdi**

**Published 2010**

**by CRC Press**

**Taylor & Francis Group, 6000 Broken Sound Parkway NW,**

**Suite 300, Boca Raton, FL 33487-2742, USA, 390pp**

**ISBN: 978-1-4200-8027-8**

Advanced polymer-based nanocomposite materials have gained in popularity for a wide range of engineering applications, with improvement of virtually all types of products and commercialisation of products that exploit their unique mechanical, thermal, and electrical properties. However, these properties present new challenges in understanding, predicting, and managing potential adverse effects, such as toxicity and the impact of exposure on human lives and the environment.

Included in this book are 12 chapters organised into two main sections: 'Nanostructured polymers composites' and 'nano-bio composites'. All contributing authors have been working in these fields for many years. The works addressed in this book will give important guidelines and new insights for readers and will stimulate investigation of anticipated research.

The book contains the following chapters:

#### Section 1 Nanostructured polymer, composites:

- carbon nanotube polymer composites
- processing, properties, and flow behaviour of carbon nanofiber-based polymeric nanocomposites
- rheology in polymer/clay nanocomposites: Mesoscale structure development and soft glassy dynamics
- polymer/graphite nanocomposites
- polymer nanocomposite flammability and flame retardancy.

#### Section 2 Nano-bio composites:

- animal-based fiber-reinforced biocomposites
- biopolymeric nanofibers for tissue engineering
- potential use of polyhydroxyalkanoate (PHA) for biocomposite development
- the reductionist approach to the molecular and supramolecular structures of elastin
- elastin and elastin-based polymers
- PLA-based bio- and nanocomposites
- nanomaterials formulation and toxicity impact.

This book will give many researchers, scientists, and academics important information in the fields of nano9materials, biomaterials, and the up-and-coming topic-nano-biomaterials research.

#### **4 Advanced Tomographic Methods in Materials Research and Engineering**

**by: J. Banhart**

**Published 2011**

**by Oxford University Press**

**Great Clarendon Street, Oxford OX2 6DP, UK, 462pp**

**ISBN: 978-0-19-921324-5**

This book was inspired by the success of a special topical symposium at the annual spring meeting of the German Physical Society in Berlin in 2005 for which the editor was one of the organisers. Such symposia usually attract 10 to 30 papers but this particular one on 'tomographic methods in materials research' set a new record with 45 papers. This showed that there is a lot of interest in three-dimensional imaging methods both in materials science and in physics. Moreover, it became apparent that a concise treatment of 'advanced' tomographic methods is still lacking.

In contrast to the symposium, this book omits all three-dimensional imaging methods based on destroying the specimen to be investigated, e.g., by cutting, polishing, or milling. There is a reason for this, besides the obvious lack of space: although the information provided by destructive imaging can be similar to that of images obtained non-destructively, the underlying physics and mathematical algorithm differ, and the book would not have had a cohesive theme with all these methods included. With the word 'advanced' in the book title, some of the established methods based on conventional X-ray tubes, nuclear magnetic resonance scanners or other laboratory-based equipment are also excluded. This does not imply that these methods are unsophisticated: rather, the word 'advanced' is used here to reflect the fact that novel third-generation synchrotrons, modern neutron sources, and electron guns in the most sophisticated transmission electron microscopes are also being used to capture three-dimensional images of materials and components. This represents new opportunities for a large community of engineers, materials scientists, or applied physicists, who are the target group of this book in terms of profession. The book should be useful for senior undergraduates and postgraduates, as well as for postdoctoral workers.

Before beginning a description of the individual tomographic methods, some fairly general introductory chapters on the principles and mathematics of tomography, and the basic interactions between matter and the three radiation types considered, are given. Ample reference lists in each chapter allow the reader to seek out information that is not contained in the book. However, the book is conceived such that the concepts of advanced tomography can be understood without necessarily having to read further, more specialised literature.

The field of three-dimensional tomographic imaging is developing quickly, and the more the community of materials researchers gets to know the available methods, the more exciting applications will emerge from their work. One aim of this book is to stimulate such work.

The book contains the following chapters:

- introduction
- some mathematical concepts for tomographic reconstruction
- visualisation, processing and analysis of tomographic data

- radiation sources and interaction of radiation with matter
- synchrotron X-ray absorption tomography
- phase-contrast and holographic tomography
- tomography using magnifying optics
- scanning tomography
- three-dimensional X-ray diffraction
- detectors for synchrotron tomography
- fundamentals of electron tomography
- applications of electron tomography
- neutron absorption tomography
- neutron phase-contrast and polarised neutron tomography
- neutron-refraction and small-angle scattering tomography
- facilities for tomography
- examples on CD-ROM.

**5 Chaos: The Science of Predictable Random Motion**  
**by: R. Krautz**  
**Published 2011**  
**by Oxford University Press**  
**Great Clarendon Street, Oxford OX2 6DP, UK, 369pp**  
**ISBN: 978-0-19-959457-3, ISBN: 978-0-19-959458-0**

In the 30 years since chaotic motion began to make a splash in the popular press, more than 20 books on the subject have been written for general audiences. These books, listed in the bibliography, are excellent introductions to chaos but usually avoid mathematics. The author strategy in writing *Chaos* has been to explore the topic using elementary algebra, vectors, and trigonometry, while avoiding calculus. Although a little math makes the book more challenging, it also affords deeper insights into the nature and origins of chaotic behaviour. In translating author original lecture into a book. The author tried to retain some of the lighter elements, like historical sketches and computer animations. However, the final chapters take the reader into the mathematical realm of state space, where neither his lecture nor most introductory books dare to tread. These chapters rely on graphics rather than algebra to introduce the homoclinic tangle, a topological monster that lies at the heart of chaotic motion.

Based on only elementary mathematics, this engaging account of chaos theory bridges the gap between introductions for the layman and college-level texts. It develops the science of dynamics in terms of small time steps, describes the phenomenon of chaos through simple examples, and concludes with a close look at a homoclinic tangle, the mathematical monster at the heart of chaos. The presentation is enhanced by many figures, animations of chaotic motion available on a companion CD, and biographical

sketches of the pioneers of dynamics and chaos theory. To ensure accessibility to motivated high school students, care has been taken to explain advanced mathematical concepts simply, including exponentials and logarithms, probability, correlation, frequency analysis, fractals, and transfinite numbers. These tools help to resolve the intriguing paradox of motion that is predictable and yet random, while the final chapter explores the various ways chaos theory has been put to practical use.

The book contains the following chapters:

- Introduction
  - 1 chaos everywhere
- Dynamics
  - 1 Galileo Galilei-birth of new science
  - 2 Isaac Newton-dynamics perfected
  - 3 Celestial mechanics-the clock universe
  - 4 the pendulum-linear and non-linear
  - 4 Synchronisation-the Josephson effect
- Random motion
  - 1 chaos forgets the past
  - 2 chaos takes a random walk
  - 3 chaos makes noise
- Sensitive motion
  - 1 Edward Lorenz-Butterfly effect
  - 2 chaos comes of age
  - 3 tilt-a-whirl-chaos at the amusement park
  - 4 billiard-ball-atomic disorder
  - 5 iterated maps-chaos made simple
- Topology of motion
  - 1 state space-going with the flow
  - 2 strange attractor
  - 3 fractal geometry
  - 4 Stephen Smale-Horseshoe map
  - 5 Henri Poincaré-topological tangle
- Conclusion
  - 1 chaos get to work
- Bibliography
- Index.

**6 Film and Nucleate Boiling Processes, Selected Technical Papers  
STP1534, Journal of ASTM International  
by: K. Narayan Prabhu and N. Kobasko  
Published 2012  
by ASM International  
100 Barr Harbor Drive, P.O. Box C700,  
West Conshohocken, PA 19428-2959, USA, 424pp  
ISBN: 978-0-8031-7520-4**

This compilation of the *Journal of ASTM International (JAI)*, STP1534, *Film and Nucleate Boiling Processes*, contains papers published in *JAI* that discuss heat quenching technologies based on several developments. These developments include: the mechanism of film and nucleate boiling processes, calculating the duration of transient nucleate boiling mode, the accuracy of cooling curves and cooling rate measurements, the results of investigations based on use of noise control systems, and what are real and effective heat transfer coefficients.

Heat treatment of metallic alloys constitutes an important step within the production process. The heat treatment process itself is considered as a cycle of heating the work pieces to a predetermined temperature, keeping them at this temperature for the time period required, and cooling them to room temperature in an appropriate way.

The process of heating and keeping workpieces at the required temperature is nowadays well mastered and mostly automatised. The process of cooling or quenching which determines actually the resulting properties is handicapped with many physical and technical uncertainties.

The compendium discusses important problems connected with the quenching processes in heat treating industry as well as boiling problems related to the nuclear power industry. Both for heat treating industry and for nuclear power industry, the formation of film boiling should be prevented. During quenching, the film boiling results in considerable distortion, crack formation and poor mechanical properties of the material. In the nuclear power industry, film boiling can lead to overheating of the nuclear reactor. Hence, a study of film and nucleate boiling processes combined with the critical heat flux (CHF) densities are very important for the practice.

The overview shows the necessity of understanding the mechanism of film and nucleate boiling as well as the assessment of CHF density to obtain the overall picture of the process of quenching or possible occurrence of film boiling as well as the assessment of CHF density to obtain the overall picture of the process of quenching or possible occurrence of film boiling in nuclear reactor.

- 7 Nanotechnology for a Sustainable World, Global Artificial Photosynthesis as nanotechnology's Moral Culmination**  
**by: T. Faunce**  
**Published 2011**  
**by Edward Elgar Publishing Limited**  
**Cheltenham, UK, William Pratt House, 9 Dewey Court,**  
**Northampton, Massachusetts 01060, USA, 338pp**  
**ISBN: 978-1-84844-671-7**

Does humanity have a moral obligation to emphasise nanotechnology's role in addressing the critical public health and environmental problems of our age? This well crafted book explores such an idea by analysing the prospects for a macroscale nanotechnology-for-environmental sustainability project in areas such as food, water and energy supply, medicine, healthcare, peace and security. Developing and applying an innovative science-based view of natural law underpinning a global social contract, it considers some of the key scientific and governance challenges such a global project may face.

The book concludes that the moral culmination of nanotechnology is a Global Artificial Photosynthesis project. It argues that the symmetric patterns of energy creating photosynthesis, life and us are shaping not only the nanotechnological advances of artificial photosynthesis, but also the ethical and legal norms likely to best govern such scientific achievements to form a sustainable existence on this planet.

The book contains the following chapters:

- Introduction,
- Nanoscience for a sustainable world: a goal or set of principles?,
- Obstacles to nanotechnology for environmental sustainability,
- Core normative components of a global NES project,
- Nanotechnology for sustainable food, water and housing,
- Equitable access to nanomedicines,
- Nanotechnology for global peace and security,
- Nanotechnology, climate change and renewable energy,
- Nanotechnology's moral culmination: a Global Artificial Photosynthesis project.

Nanotechnology for a Sustainable World will appeal to many generations of scientists and policymakers working to improve our world in public health, environmental sustainability and renewable energy and nanotechnology. It will also be a valuable resource for similarly motivated students of chemistry, physics, biology, nanotechnology and photosynthesis, as well as environmental and energy ethics, law and policy.

## **8 Handbook of Research on Cluster Theory**

**by: C. Karlsson**

**Published 2012**

**by Edward Elgar Publishing Limited**

**Cheltenham, UK, William Pratt House, 9 Dewey Court,**

**Northampton, Massachusetts 01060, USA, 316pp**

**ISBN: 978-1-84542-516-6**

This »Handbook of Research on Cluster Theory« is intended to provide a comprehensive information source for scientists, students, policy makers and cluster managers keen to have an up-to-date overview of agglomeration and cluster theory, cluster research methods, clustering in different spatial contexts and clustering in service industries. A parallel »Handbook of Research on Innovation and Clusters: Cases and Policies' will present a similar up-to-date overview of clustering in high-tech industries, cluster case studies and cluster policies. A rich empirical material in both handbooks makes it possible to learn lessons from cluster experiences in many different industries and countries in Europe and North America.

The book contains the following chapters:

### Part I Agglomeration and cluster theory

- Agglomeration economics;
- The analysis of location, colocation and urbanisation economies;
- The knowledge spillover theory of entrepreneurship and spatial clusters;
- Knowledge-based clusters: regional multiplier models and the role of »buzz«;
- Clusters formation from the »bottom-up«: a process perspective;
- Cluster life-cycles: an emerging synthesis;
- Clustering in space versus dispersing over space.

### Part II Cluster research methods

- Industrial clusters in the input-output economic system;
- Clustering using wavelet transformation.

### Part III Clusters in different spatial contexts

- Industrial districts: theoretical and empirical insights;
- Cluster renewal in old industrial regions: continuity or radical change?;
- The reciprocal relationship between transnationals and clusters: a literature review;
- Diversity and the case against specialised clusters.

### Part IV Sectoral clusters

- Clustering in financial services;
- Spatial clustering of culture;
- Clustering in the broadcasting industry;
- Tourism clusters.