# Book Reviews

## Reviewed by Janez Grum

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1　**Micromanufacturing Processes**
　**by: V.K. Jain**
　**Published 2013**
　**by CRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway**
　**NW, Suite 300, Boca Raton, FL 33487-2742, USA, 411pp**
　**ISBN: 978-1-4398-5290-3**

This introductory book on micromanufacturing is the result of the combined efforts of more than 45 eminent professors and researchers. All these authors are actively engaged in teaching, research or development activities in the specific areas about which they have written. The basic objective of this book is to acquaint readers with the principles, basic machine tools and latest developments in micromanufacturing processes.

Nowadays, meso- and micromanufacturing are emerging as important technologies, especially in areas where miniaturisation yields economic and technical benefits, namely, the aerospace, automotive, optical and biomedical industries. With time, miniaturisation of machines and devices is leading to further demand for parts with dimensions of the order of a few micrometres to a few hundred nanometres. The demand of industries for micromanufacturing of various types of materials (metallic, ceramics and plastics) is also increasing by the day. Some examples of the products that require micromanufacturing are microholes in optical fibres, micronozzles for high-temperature jets and micromolds. Scientists and researchers are engaged in developing nanofeatured products such as nanoelectromechanical systems. Hence, it is quite safe to say that there is a need for manufacturing processes that are capable of dealing with atomic and molecular dimensions.

This book deals with processes that come under the category of micromanufacturing processes. The book is divided into six major parts:

- Section I Introduction: micromanufacturing, challenges in meso-, micro- and nanomanufacturing.

- Section II Micromachining: microturning, microgrinding, biomachining-acidithiobacillus-genus-based metal removal, micro- and nanomanufacturing by focused ion beam.

- Section III Nanofinishing: magnetorheological and allied finishing processes, magnetic abrasive finishing, abrasive flow finishing for micromanufacturing.

- Section IV Microjoining: laser microwelding, electron beams for macro- and microwelding applications.

- Section V Microforming: micro- and nanostructured surface development by nano plastic forming and roller imprinting, microextrusion and microbending with laser.

- Section VI Miscellaneous: dimensional metrology for micro-mesoscale manufacturing, micromolding – a soft lithography technique, fabrication of microelectronic devices, an integrated wafer surface evolution model for chemical mechanical planarisation.

This book deals not only with various micromanufacturing processes but also with measurement techniques and other essential topics, making it a good textbook for undergraduate and postgraduate students as well as a reference book for researchers. This book has a large number of cross-references that will help readers with further in-depth study of a particular area of specialisation.

## 2    Measurements and Their Uncertainties: A Practical Guide to Modern Error Analysis
**by: I.G. Hughes and T.P.A. Hase**
**Published 2011**
**reprinted 2010, 2011, 2012 by OXFORD University Press**
**Great Clarendon Street, Oxford OX2 6DP, UK, 136pp**
**ISBN: 978-0-19-956632-7 (hbk), ISBN: 978-0-19-956633-4 (pbk)**

This hands-on guide is primarily intended to be used in undergraduate laboratories in the physical sciences and engineering. It assumes no prior knowledge of statistics. It introduces the necessary concepts where needed, with key points illustrated with worked examples and graphic illustrations. In contrast to traditional mathematical treatments it uses a combination of spreadsheet and calculus-based approaches, suitable as a quick and easy on-the-spot reference. The emphasis throughout is on practical strategies to be adopted in the laboratory.

Error analysis is introduced at a level accessible to school leavers and carried through to research level. Error calculation and propagation is presented though a series of rules-of-thumb, look-up tables and approaches amenable to computer analysis. The general approach uses the chi-square statistic extensively. Particular attention is given to hypothesis testing and extraction of parameters and their uncertainties by fitting mathematical models to experimental data. Routines implemented by most contemporary data analysis packages are analysed and explained. The book finishes with a discussion of advanced fitting strategies and an introduction to Bayesian analysis.

The book contains the following chapters:

- Errors in the physical sciences

- Random errors in measurements

- Uncertainties as probabilities

- Error propagation

- Data visualisation and reduction

- Least-squares fitting of complex functions

- Computer minimisation and the error matrix

- Hypothesis testing – how good are our models?

- Topics for further study

- Topics for further study.

**3    Integrated Computational Materials Engineering (ICME) for Metals:
Using Multiscale Modelling to Invigorate Engineering Design with
Science
by: M.F. Horstemeyer
Published 2012
by TMS, WILEY, John Wiley & Sons, Inc. publication Hoboken
New Jersey, 111 River Street, Hoboken, NJ 07030-5774, USA, 430pp
ISBN: 978-1-118-02252-8 (cloth)**

The great progress that is inherent in this novel integrated computational materials engineering (ICME) approach is its practical perspective toward solving engineering design tasks in a holistic way by combining exact ab initio simulations with finite element analysis of complex microstructures and failure prediction.

These three columns of the author's novel hierarchical approach are the essence of modern computational materials engineering. First, as initio simulations can provide exact intrinsic thermodynamic and structure information that cannot be obtained by any other theory. This part of the approach follows the tenet that simulations should be as simple as possible but not simpler. Second, such generic first-principle predictions enter into mesoscopic models that capture the interaction of the different phases and defects. This modelling level is essential as modern engineering materials are often characterised by complex multiphase, multidefect and multimechanism microstructures. Third, these microstructure models are combined with adequate structure–property relationships, placing particular attention on defect initiation and growth. This is essential as reliable failure prediction is one of the main ultimate goals in structural design. In real engineering parts, it is particularly the lifetime that matters for final products such as engines, planes structures or power plant structures.

This excellent book is an absolute must for everyone active or interested in computational materials and design engineering, written by the leader of the exiting new field of ICME.

The book contains the following chapters:

- An introduction to integrated computational materials engineering (ICME)

- Microscale continuum internal state variable (ISV) plasticity – damage theory and multistage fatigue (MSF)

- Mesoscale analysis: Continuum theory methods with discrete features/methods

- Discrete dislocation dynamics simulations

- Atomistic modelling methods

- Electronic structure calculations

- Case study: From atoms to autos: A redesign of a Cadillac control arm

- Case study: Conducting a structural scale metal forming finite element analysis starting from electronics structures calculations using ICME tools

- The near future: ICME for the creation of new materials and structures.

**4    Journal of ASTM International Selected Technical Papers STP1535 Static and Dynamic spinal Implants: Are We Evaluating Them Appropriately?**
**by: L.M. Jensen, D.B. Spenciner, J. Graham and P.A. Anderson**
**Published 2012**
**by ASM International, 100 Barr Harbor Drive, PO Box C700**
**West Conshohocken, PA 19428-2959, USA, 290pp**
**ISBN: 978-0-8031-7521-1 (alk. paper)**

The ASTM International Committee F04 on Medical and Surgical Materials and Devices and F04.25 sponsored a symposium titled, "Static and Dynamic Spinal Implants: Are We Evaluating hem Appropriately?" The primary goal of the symposium was to invite discussion among the 113 attendees regarding how spinal devices are evaluated world-wide. There were 25 presentations and then posters (of nearly 50 submitted) from researchers representing the USA and five other countries. All presenters were encouraged to submit manuscripts for inclusion in this publication. From these efforts, the 20 manuscripts which make up this STP emerged. The peer review process was stringent and we hope that you find this compilation to be a useful resource in the years ahead. The symposium papers published with the current STP can be loosely grouped into four subjects: interbody fusion devices, disc and nucleus devices, in vitro testing methods and longitudinal systems.

*Interbody fusion devices*: The goal of this session was to examine several test parameters used in the evaluation of interbody spacers and other fusion devices (ASTM F2077).

*Disc and nucleus devices*: At the first symposium, testing of artificial discs was in its infancy, but the breadth of the current papers shows an evolving sophistication to test engineer's knowledge.

*In vitro testing methods*: This session represented a departure from the previous symposium. Despite the fact that in vitro kinematic testing of spines has been performed for decades, no current effort exists within ASTM for an in vitro testing standard.

*Longitudinal systems*: This topic was expanded to two sessions in the symposium due to the greater number of submissions and higher level of interest. Several papers address various aspects of the standard including suggested improvements. Other papers describe innovative uses for the standard in evaluating new types of rods technologies.

*Significance and future work*: The 2010 symposium, with its Question & Answer sessions and subsequent discussion at the regularly scheduled subcommittee meeting, revealed many areas in which Subcommittee F04.2's standards could be improved.

**5    A Dictionary of Statistics**
      **by: Graham Upton and Ian Cook**
      **First published 2011, Second edition 2006, Second edition revised 2008,**
      **Reprinted with corrections 2011**
      **by OXFORD University press, Great Clarendon Street**
      **Oxford OX2 6DP, UK, 453pp**
      **ISBN: 978-0-19-954145-4**

In deciding on the topics for inclusion, they have had to think of the probable users. Many of the people using this dictionary as an *aidemémoire* in Statistics will be those who are meeting the subject for the first time, as students at school of university. Another large group of readers will be specialists in other subjects who have found the need to analyse their own data and have then encountered the gobbledegook associated with computer packages. Our selection of topics has been made with all of these people in mind.

Dictionaries vary widely in style. This became very apparent to us once they started on this project. We have taken the view that if a reader needs to look up an 'elementary' topic then that reader may well need a rather long explanation, possibly with an example. Conversely, a reader statistical knowledge needs rather less help.

They have included approximately 150 short biographies. The criterion for inclusion has been that the individual concerned has made an important contribution to the development of the subject of Statistics or that the individual's name forms part of the title of a topic.

The dictionary concludes with a glossary, tables, a brief overview of the history of statistics and suggestions for further reading.

This leading dictionary clearly explains even the most complex statistic terms. It is an authoritative resource for students and teachers of statistics and the related fields of economics, politics, market research and mathematics, as well as for anyone who uses statistics professionally.

- Over 2000 entries – including 200 biographies of key figures in statistics.

- Generously illustrated with useful figures and diagrams, plus worked examples.

- Appendices of mathematical and statistical notation, and statistical tables.

- Recommended web links for many entries updated via the Dictionary of Statistics companion website: www.oup.com/uk/reference/resources/statistics.

**6    A Student's Guide to Data and Error Analysis
by: Herman J.C. Berendsen
Published 2011
by Cambridge University Press, The Edinburgh Building
Cambridge CB2 8 RU, UK, 225pp
ISBN: 978-0-521-11940-5 (Hardback), ISBN: 978-0-521-13492-7
(Paperback)**

This book is written as a guide for the presentation of experimental data including a consistent treatment of experimental errors and inaccuracies. It meant for experimentalists in physics, astronomy, chemistry, life sciences and engineering. However, it can be equally useful for theoreticians who produce simulation data: they are often confronted with statistical data analysis for which the same methods apply as for the analysis of experimental data. This is the problem area encountered by most physical scientists and engineers. The problem area of experimental design and hypothesis testing – excellently covered by many textbooks – is only touched on but not treated in this book.

This book contains the following chapters:

*Part I*: Data and error analysis

- Introduction

- The presentation of physical quantities with their inaccuracies

- Errors: classification and propagation

- Probability distributions

- Processing of experimental data

- Graphical handling of data with errors

- Fitting functions to data

- Back to Bayes: knowledge as a probability distribution

- Answers to exercises

*Part II*: Appendices

- Combining uncertainties

- Systematic deviations due to random errors

- Characteristic function

- From binomial to normal distributions

- Central limit theorem

- Estimation of the variance

- Standard deviation of the mean

- Weight factors when variances are not equal

- Least-squares fitting

*Part III*: Python codes

*Part IV*: Scientific data

The text can be used in education on error analysis, either in conjunction with experimental classes or in separate courses on data analysis and presentation. It is written in such a way – by including examples and exercises – that most students will be able to acquire the necessary knowledge from self study as well. The book is also meant to be kept for later reference in practical applications. For this purpose, a set of 'data sheets' and a number of useful computer programs are included.

Plenty of examples, exercises and solutions are provided to aid and test understanding, whilst useful data, tables and formulas are compiled in a handy section for easy reference.

## 7   Ultrasonic and Electromagnetic NDE for Structure and Material Characterisation
**Engineering and Biomedical Applications**
**by: Tribikram Kundu**
**Published 2012**
**by CRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL 33487-2742, USA, 875pp**
**ISBN: 978-1-4398-3663-7 (hardback)**

The book provides a comprehensive and rigorous approach of the fundamentals of linear and nonlinear ultrasonics and electromagnetic methods, including a chapter on the newly emerging THz technique. The book also provides enough advanced engineering and biological applications to make the reader familiar with these technologies, including applications of guided waves, nonlinear ultrasonics, laser-ultrasonics, acoustic microscopy and fibre optics.

Most books on nondestructive evaluation (NDE) focus either on the theoretical background or on advanced applications. Bridging the gap between the two Ultrasonic and Elecromagnetic NDE for Structure and Material Characterisation: Engineering and Biomedical Applications brings together the principles, equations and applications of ultrasonic and electromagnetic NDE in a single, authoritative resource. This is also one of the first book to incorporate a number of popular NDE methods based on electromagnetic techniques. Written in plain language by some of the world's leading experts, the text begins with the relevant fundamentals of mechanics and electromagnetic theory, derives the basic equations, and then, step by step, covers state-of-the-art topics and applications of ultrasonic and electromagnetic NDE that are the forefront of research.

The book contains the following chapters:

- Mechanics of Elastic Waves and Ultrasonic Nondestructive Evaluation

- Modelling of Ultrasonic Fields by Distributed Point Source Method

- Electromagnetic Nondestructive Evaluation

- Distributed point Source Method for Modelling and Imaging in Electrostatic and Electromagnetic Problems

- Guided waves for Plate and Pipe Inspection

- Fundamentals and Applications of Nonlinear Ultrasonic Nondestructive Evaluation

- Theory and Applications of Laser Ultrasonic Techniques

- Material Characterisation by Nonlinear Ultrasonic Technique

- Toward Structural Health Monitoring Solutions for Bolted Joints

- Measurement of the Elastic Properties of Solids by Brillouin Spectroscopy

- Theory and Applications of Scanning Acoustic Microscopy and Scanning Near-Field Acoustic Imaging

- Ultrasonic Characterisation of Biological Cells

- Ultrasonic Characterisation of Hard Tissues

- Clinical Applications of Ultrasonic Nondestructive Evaluation

- Terahertz Radiation for Nondestructive Evaluation

- Fibre-Optic Sensors for Structural Health Monitoring

This makes this book an excellent text for a senior/first-year graduate course in nondestructive testing and evaluation or as a text in a course in engineering and biological materials characterisation. It is also an excellent reference book for practicing engineers and scientists.

**8    Modelling Materials Continuum, Atomistic and Multiscale Techniques**
**by: Ellad B. Tamor and Ronald E. Miller**
**Published 2011**
**by Cambridge University Press, The Edinburgh Building**
**Cambridge CB2 8 RU, UK, 759pp**
**ISBN: 978-0-521-85698-0 (Hardback)**

Material properties emerge from phenomena on scales ranging from angstroms to millimetres, and only a multiscale treatment can provide a complete understanding. Materials researchers must therefore understand fundamental concepts and techniques from different fields, and these are presented in a comprehensive and integrated fashion for the first time in this book.

Incorporating continuum mechanics, quantum mechanics, statistical mechanics, atomistic simulations and multiscale techniques, the book explains many of the key theoretical ideas behind multiscale modelling. Classical topics are blended with new techniques to demonstrate the connections between different fields and highlight current research trends. Example applications drawn from modern research on the thermomechanical properties of crystalline solids are used as a unifying focus throughout the text.

Together with its companion book *Continuum Mechanics and Thermodynamics* (Cambridge University Press 2012), this work presents the complete fundamentals of materials modelling for graduate students and researchers in physics, materials science, chemistry and engineering.

The book contains the following chapters:

- Introduction

- Part I: Continuum mechanics and thermodynamics: Essential continuum mechanics and thermodynamics

- Part II: Atomistics: Lattices and crystal structures, Quantum mechanics of materials, Empirical atomistic models of materials, Molecular statistics

- Part III: Atomistic foundations of continuum concepts: Classical equilibrium statistical mechanics, Microscopic expressions for continuum fields, Molecular dynamics

- Part IV: Multiscale methods: What is multiscale modelling?, Atomistic constitutive relations for multilattice crystals, Atomistic-continuum coupling: static methods, Atomistic-continuum coupling: finite temperature and dynamics

- Appendix A: Mathematical representation of interatomic potentials