
Book Reviews

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1 Inspection of Metals, Understanding the Basics

by: F.C. Campbell

Published 2013

by ASM International, Materials Park, Ohio 44073-0002, USA,

www.asminternational.org, 487pp

ISBN-13: 978-1-62708-000-2, ISBN-10: 0-62708-000-7, SAN: 204-7586

Inspection of metals is used to ensure that the quality of the part or product meets minimum quality and safety requirements. There are hundreds of methods used to inspect metals during its fabrication, when the part is completed and ready for final inspection, and during its service life. While the three stages of inspection are addressed to some extent in this book, the emphasis is no final part inspection. Because it is not possible to address all the different inspection methods used in the industry, only the most widely used inspection methods are covered.

The first half of this book attempts to answer three questions for each of these inspection methods:

- How is the inspection methods performed?
- When is it used?
- How does it compare with other inspection methods?

The book contains the following chapters:

- Visual inspection
- Machine vision
- Coordinate measuring machines
- Machine vision
- Hardness testing
- Tensile testing
- Chemical composition
- Metallography

- Liquid penetrant, magnetic particle and eddy current inspection
- Radiographic inspection
- Ultrasonic inspection.

The second half of the book covers how these inspection methods are used in different metal fabrication industries:

- Casting
- Steel bar and wire
- Tubular products
- Forging
- Powder metallurgy parts
- Weldments and brazed assemblies.

Since the purpose of this book is to cover the basics of inspections of metals, the reader is referred to more advanced texts for detailed information. In particular, for nondestructive test methods *Nondestructive Evaluation and Quality Control*, Volume 17 *ASM Handbook*, for mechanical property test methods, *Mechanical Testing and Evaluation*, Volume 8, *ASM Handbook*, and for metallography *Metallography and Microstructures*, Volume 9 *ASM Handbook*.

2 Alloying: Understanding the Basics

by: J.R. Davis

Published 2005

**by ASM International, Materials Park, Ohio 44073-0002, USA,
www.asminternational.org, 487pp**

First printing, December 2001, second printing, January 2003,

Third printing, April 2005, digital printing, March 2011,

ISBN-13: 978-0-87170-744-4, ISBN-10: 0-87170-744-6, SAN: 204-7586

Alloying may be defined as “the process of adding one or more elements or compounds to interact with a base metal in order to obtain beneficial changes in its mechanical, physical or chemical properties or manufacturing/processing characteristics”. For the purposes of this publication, the definition has been limited to those alloying processes that affect the *bulk* of the materials; therefore, surface alloying processes such as carburising, nitriding, ion implantation, and hot dip galvanising are not covered. However, elements or compounds that lead to a preferential microstructure and subsequent improved properties are covered. Examples of these are grain refiners, inoculations added to molten cast irons to produce changes in graphite distribution and improvements in mechanical properties, magnesium-containing nodulising (or spheroidising) additions in ductile irons for high strength and ductility (up to 18% elongation), and the addition of certain elements, such as calcium, sodium, strontium, and antimony, to refine the structure of aluminium-silicon casting alloys as well as improve their tensile properties and ductility. Also included are discussions of some powder

metallurgy (P/M) materials that technically may fall outside the definition of alloying given above. An example is copper-base dispersion strengthened materials. Copper can be strengthened by using fine dispersed particles of aluminium oxide. Because this oxide is not immiscible in liquid copper, dispersion-strengthened copper cannot be made by conventional ingot metallurgy and alloying techniques; P/M techniques must be used. Dispersion-strengthened superalloys made by 'mechanical alloying' are also described.

This book contains the following chapters:

- Introduction
- Cast iron
- Carbon and alloy steels
- Stainless steel and heat-resistant alloys
- Light metals and alloys
- Other nonferrous alloys
- Special purpose alloys.

3 Fundamentals of Tribology

by: R. Gohar and H. Rahnejat

Published 2012

**by Imperial College Press, 57 Shelton Street, Covert Garden,
London WC2H 9HE, 472pp**

2nd Edition, ISBN-13 978-84816-860-2, ISBN-10 1-84816-860-8

This textbook of Tribology, or Lubrication and wear, as the subject was previously called, is an outgrowth of research and teaching by the authors, over many years, to undergraduate mechanical engineering students at Imperial College of London and Loughborough University. The book represents our ideas on how Tribology should be taught to modern engineering students who, unlike their predecessors, now generally have at their disposal the support of comprehensive computer system. We hope the book will also be of use to practicing engineers who frequently encounter Tribology-centred problems, and who require quick, but adequate solutions.

Fundamentals of Tribology deals with the fundamentals of lubrication, friction and wear. It begins by introducing the reader to the importance of tribology in everyday life and offers a brief history of the subject. It then describes the nature of rough surface and the mechanics of contacting elastic solids and their deformations under load and friction in their relative motion. The book goes on to discuss the importance of lubricant rheology with respect to viscosity and density. Then, the principles of hydrodynamic lubrication are covered with derivations of the governing Reynolds and energy equations. Applications of hydrodynamic lubrication in various forms of bearing – journal bearings, thrust bearings and externally pressurised bearings – are outlined. The important and still evolving subject of elasto-hydrodynamic lubrication is treated in some details, both at its fundamentals and its applications in thin shell or overlay bearings, cam-followers and internal combustion engine pistons. The fundamentals of biotribology are also covered, particularly its applications to endo-articular mammalian joints such as hip and knee

joints and their arthroplasty. In addition, there is a treatment of rapidly emerging knowledge of tribological phenomena in lightly vanishing conjunctions in natural systems and very small devices such as MEMS and high density data storage media. The book ends with a selection of practical questions for each chapter along with worked solutions where appropriate.

This book targets the undergraduate and postgraduate body as well as engineering professionals in industry, where often a quick solution or understanding of certain tribological fundamentals into certain aspects of tribology.

This book contains the following chapters:

- Introduction to Tribology
- The Nature of Rough Surfaces
- Elastic Solids in Normal Contact
- Dry Friction and Wear
- Lubricant Properties
- The Reynolds and Energy Equations
- Thrust Bearings
- Journal Bearings
- Externally Pressurised (EP) Bearings
- Elastohydrodynamic Lubrication (EHL)
- Fatigue Life of Rolling Element Bearings
- Transient Elastohydrodynamic Lubrication
- Nano-Tribology
- Bio-Tribology.

4 Modelling Materials Continuum, Atomistic and Multiscale Techniques

by: E.B. Tadmor and R.E. Miller

Published 2011

by Cambridge University Press, The Edinburgh Building,

Cambridge CB2 8RU, UK, 759pp

ISBN 978-0-521-85698-0 (Hardback)

This book contains the following chapters:

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

- Part II: Atomistic
 - Lattices and crystal structures
 - Quantum mechanics of materials
 - Empirical atomistic models of materials
 - Molecular statics
- Part III: Atomistic foundations of continuum concepts
 - Classical equilibrium statistical mechanics
 - Microscopic expression for continuum fields
 - Molecular dynamics
- Part IV: Multiscale methods
 - What is multiscale modelling?
 - Atomistic constitutive relations for multilattice crystals
 - Atomistic-continuum coupling: statistic methods
 - Atomistic-coupling finite temperature and dynamics
 - Appendix A: Mathematical representation of interatomic potentials.

Studying *materials* can mean studying almost anything, since all of the physical, tangible world is necessarily made of *something*. Normally, we think of studying materials in the sense of materials science and engineering – an endeavour to understand the properties of natural and man-made materials and to improve or exploit them in some way – but even this includes broad and disparate goals. One can spend a lifetime studying the strength and toughness of steel, for example, and never once concern oneself with magnetic and electric properties. At the same time, *modelling* in science can mean many things to many people, ranging from computer simulation to analytical theories to abstract mathematics. To combine these two terms ‘modelling materials’ as the title of single book, then, is surely to invite disaster. How could it be possible to cover all the topics that the product *modelling* \times *materials* implies? Although this book remains true to its title, it will be necessary to pick and choose our topics so as to have a manageable scope, to start with, then, we have to decide: what models and what materials do we want to discuss?

As far as modelling goes, we must first recognise the fact that materials exhibit phenomena on a broad range of spatial and temporal scales that combine together to dictate the response of material. These phenomena range from the response of a material. These phenomena range from the bonding of individual atoms governed by quantum mechanics to microscopic deformation processes described by continuum mechanics. Various aspects of materials and modelling, which tends to focus on specific phenomena at a given scale, have traditionally been treated by different disciplines in science and engineering. The great disparity in scales and the interdisciplinary nature of the field are what makes modelling materials both challenging and exciting. It is unlikely that any one researcher has sufficient background in engineering, physics, materials science and mathematics to understand materials modelling at everyday length and time scale.

Furthermore, there is increased awareness that materials modelling must be understood, not *only* by rigorous treatment of phenomena at each of these scales alone, both rather through consideration of the interactions between these scales. This is paradigm of *multiscale* modelling that will also be persistent theme throughout the book.

5 Ceramic Lasers

by: A. Ikesue, Y. Lin Aunge and V. Lupei

Published 2013

**by Cambridge University Press, The Edinburgh Building,
Cambridge CB2 8 RU, UK, 445pp**

ISBN 978-0-521-11408-0 (Hardback)

Research and development on various types of solid-state laser has been carried out since the creation of the first ruby laser by Dr. T Maiman in 1960. Examples of laser technologies include continuous wave (CW) laser using Nd: YAG (neodymium-doped yttrium aluminium garnet) single crystals at room temperature developed by Dr. Geusic in 1964, and tunable and ultra-short pulse laser using Ti: sapphire single crystals developed by P.F. Moulton in 1982. These laser are still being applied in industrial applications.

On the other hand, it is said that people started to use porcelain as standard tableware in the days before Crist. In the USA, modernisation of ceramic technology started in the 1950s. Ceramics have now become an essential part of technologies that support industrial such as electronics and engineering etc., and their industrial use has expanded greatly from year to year.

The book contains the following chapters:

- Introduction
- Solid-state laser processes and active materials
- Experimental technique: powder characteristics and synthesis of optical grade ceramics, effects of sintering aids
- Synthesis of polycrystalline ceramic lasers (RE-doped sesquioxides)
- Synthesis of RE (Nd) heavily doped YAG ceramics
- Optical scattering centres in polycrystalline ceramics
- Advanced technologies in ceramics (composite, fibre, single crystal by sintering method, etc.)
- Current R&D status of ceramic laser worldwide
- The future of ceramic technology
- High resolution optical spectroscopy and emission decay of laser ceramics
- Ceramic lasers.

The interaction of ceramics with optics originated from the success that was achieved by Dr. R.L. Coble of Massachusetts Institute of Technology in the late 1950s. He succeeded

in fabricating alumina ceramics including fewer residual pores by controlling the microstructure. This material exhibited translucency and was applied as a discharge tube in high-pressure sodium vapour lamp, thus contributing to the advancement of lighting technology. Research and development of various types of translucent and transparent ceramics then occurred around the world, but the optical quality of the translucent ceramics was much inferior to that of commercial single crystal and glass materials. In addition, there were no practical application of these ceramics at that time, and most of the translucent ceramics were only of interest for laboratory research.

Until recently, ceramic materials were considered unsuitable for optics due to the numerous scattering sources, such as grain boundaries and residual pores. However, in the 1990s the technology to generate a coherent beam from ceramic materials was developed, and highly efficient laser oscillation was realised. In the future the technology derived from the development of the ceramic laser could be used to develop new functional passive and active optics.

Co-authored by one of the pioneers of this field, the book describes the fabrication in technology and theoretical characterisation of ceramic material properties. It describes novel types of solid lasers and other optics using ceramic materials to demonstrate the application of ceramic gain media in generation of coherent beams and light amplification.

This is an invaluable guide for physicists, materials scientists and engineers working on laser ceramics.

6 Having Success with NSF: A Practical Guide

by: P. Li and K. Marrongelle

Published 2013

by WILEY, John Wiley & Sons, Inc. Hoboken, New Jersey,

111 River Street, Hoboken, NJ 07030-5774, USA, 166pp

ISBN 978-1-118-01398-4 (pbk.)

The experience of writing research proposal for funding is essential today for scientist of all ranks. In the process of writing and submitting grant proposals, researchers can better organise their thoughts for exactly what they want to do in a new project, which methods they want to use, how long they plan to do the research, and so on. Even if research funding is not obtained, the exercise of proposal writing is often beneficial to the research process, sometimes almost as important as the actual research itself. Today people are also mindful that there is a huge pressure especially on early-career investigations, to write proposal and bring grant dollars to the researcher's home institutions, one's ability to seek and receive funding from federal grant agencies is often used as a yardstick for important personnel decisions by the institution's administration.

Being among the highly competitive applications who receive a National Science Foundation grant in a given year is not only helpful to your research, but also to your career. Bringing grant dollars to your home institution is yardstick often used by administrators making personal decisions.

Written by two NSF grant recipients who later served as NSF program directors, *Having Success with NSA* helps you write and submit a winning NSF proposal. It explains aspects of the submission and review process that are not typically understood by the research community, and walks through each stage of the process from grant preparation and presentation to re-submission and management of grant award.

This one-of-a-kind guide:

- Addresses the new NSF Merit Review Principles and Criteria as of 2013
- Takes a practical approach to conceiving, writing, and submitting an NSF proposal
- Addresses FAQs the authors received as NSF program directors
- Discusses what you do not know about the proposal review process
- Contains sample letters and various templates for NSF required documents
- Makes an excellent reference for grand student seminars in grant writing.

Filled with tips not found in official paperwork, *Having Success with NSA* provides the expert guidance you need to navigate the NSF proposal process and come out an NSF grant recipient.

The book contains the following chapters:

- Getting Started
- Preparing Your Proposal
- Submitting Your Proposal
- Reviewing of Your Proposal
- Revising Your Proposal
- Managing Your Proposal
- Extending the Horizon.

7 Chaos, CNN Memristors and Beyond: A Festschrift for Leon Chua
by: A. Adamatzky and G. Chen
Published 2013
by World Scientific Publishing Co. Pte. Ltd. 5 Toh Tuck Link,
Singapore 596224, USA office: 27 Warren Street Suite 401-402,
Hackensack, NJ 07601, UK office: 57 Shelton Street, Covent Garden,
London, WC2H 9HE, 564pp
ISBN 978-981-4434-79-9

This invaluable book is a unique collection of tributes to outstanding discovering pioneered by Leon Chua in nonlinear circuits, cellular neural networks, and chaos. It is comprised of three parts. The first – cellular nonlinear networks, nonlinear circuits and cellular automata – deals with Chua's Lagrangian circuits, cellular wave computers, bio-inspired robotics and neuro-morphic architectures, toroidal chaos, synaptic cellular automata, history of Chua's cardiac arrhythmias, local activity principle, symmetry

breaking and complexity, bifurcation trees, and Chua's views on nonlinear dynamics of cellular automata. Dynamical system and chaos is the scope of the second part of the book, where we find genius accounts on theory and application of Julia set, stability of dynamical networks and neocortical dynamics, dynamics of piecewise linear systems, chaotic mathematical circuitry, synchronisation of oscillators, models of catastrophic events, control of chaotic systems, symbolic dynamics, and solitons. Firsthand accounts on the discovery of memristors in HP Labs, historical excursions into 'ancient memristors', analytical analysis of memristors, and hardware memristor emulators are presented in the third and final part of the book.

The book is quintessence of ideas on future and emergent hardware, analytic theories of complex dynamical systems and interdisciplinary physics. It is a true Renaissance volume where bright ideas of electronics, mathematics and physics enlighten facts of modern science.

The unique DVD covers the artistic aspects of chaos, such as several stunningly melodious musical compositions using chaotic attractors, a virtual gallery of hundreds of colourful attractors, and even a cartoon-like play on the genesis of Chua's circuit that was based on a widely acclaimed performance in Rome and other venues in Italy. In short, it is a veritable kaleidoscope of never-before-published historical, pedagogical and futuristic technical visions on three timely topics of intense interest for both lay readers and experts alike.

8 Introduction to Computational Materials Science, Fundamentals to Applications

by: R. Lesar, MRS Materials Research Society

Published 2013

by Cambridge University Press, The Edinburgh Building, Cambridge

CB2 8 RU, UK, 414pp

ISBN 978-0-521-84587-8 (Hardback)

The goal of this book is to introduce the basic methods used in the computational modelling of materials. The text reflects many tradeoffs: breadth vs. depth, pedagogy vs. detail, topic vs. topic. The intent was to provide a sufficient background in the theory of these methods that the student can begin to apply them to the study of materials. That said, it is not a 'computation' book – details of how to implement these methods in specific computer languages are not discussed in the text itself, though they are available from an online resource, which will be described a bit later in this preface.

Modelling and simulation are becoming critical tools in the materials researcher's tool box. The text will help at once and prepare the next generation of materials modellers, whether modelling is their principal focus or not.

Emphasising essential methods and universal principles, this textbook provides everything students need to understand the basics of simulating materials behaviour. All the key topics are covered, from electronic structure methods to microstructural evolution, appendices provide crucial background material, and a wealth of practical resources are available online to complete the teaching package.

- Examines modelling materials across a broad range of scales, from the atomic to the mesoscale, providing students with a solid foundation for future study and research.
- Presents detailed, accessible explanations of the fundamental equations underpinning materials modelling, and includes a full chapter summarising essential mathematical background.
- Extensive appendices, including essential background on classical and quantum mechanics, electrostatics, statistical thermodynamics and linear elasticity, provide all the background necessary to fully engage with the fundamentals of computational modelling.
- Exercises, worked examples, computer codes and discussions of practical implementations methods are all provide online to give students the hands-on experience they need.

**9 Materials Processing Fundamentals,
Proceeding of a Symposium Sponsored by the TMS Process Technology
and Modelling Committee and Extraction and Processing Division Held
during the TMS 2013 Annual Meeting & Exhibition San Antonio, Texas,
USD, 3–7 March, 2013**
by: L. Zhang, A. Allanore, C. Wang, J.A. Yurko and J. Crapps,
The Minerals, Metals & Materials Society
Published 2013
by WILEY, John Wiley & Sons, Inc. Hoboken, New Jersey,
111 River Street, Hoboken, NJ 07030-5774, USA, 318pp
ISBN 978-1-11860-598-1

The key interest areas to be covered in the symposium of Materials Processing Fundamentals are all aspects of the fundamentals, synthesis, analysis, design, monitoring, and control of metals, materials, and metallurgical processes and phenomena.

Topics will include:

- The experimental, analytical, physical and computer modelling of physical chemistry and thermodynamic.
- Transport phenomena in materials and metallurgical process involving iron, steel, non-ferrous metals, and composites.
- Second phase particles in metals and processes, such as non-metallic inclusions and bubbles in metals (steel, aluminium, silicon, magnesium, etc.) or gas bubbles in slag or electrolyte (foaming, gas evolution or injection); the fundamentals (experimental studies or theoretical studies) on the nucleation, growth, motion and removal of these second phase particles from the molten metal or reactors.
- Physical chemistry, thermodynamics and kinetics for the production and refining or rare earth metals.

- Control of industrial processes in the field of extraction and processing of metals and materials: novel sensors for hostile-environmental materials processes, such as online inclusion detection, temperature, and velocity in molten materials, surface condition of hot moving products, etc.; innovative online sampling and analysis techniques; models for real-time process control and quality monitoring systems.

The book contains the following sessions presentations:

- Process Metallurgy of Steel
- Physical Metallurgy of Metals
- Metallurgy of Non-Ferrous Metals
- Process Metallurgy of Non-Ferrous Metals
- Recirculation of Materials and Environments.

10 Optical, Acoustic, Magnetical and Mechanical Sensor Technologies

by: Krzysztof Iniewski

Published 2012

**by CRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway
NW, Suite 300, Boca Raton, FL 33487-2742, USA, 345pp**

ISBN 978-1-4398-6975-8 (Hardback)

Light on physics and math, with a heavy focus on practical applications, Optical, Acoustic, Magnetic and Mechanical Sensor Technologies discusses the development necessary to realise the growth of truly integrated sensors for use in physical, biological, optical and chemical sensing, as well as future micro- and nanotechnologies.

Used to pick up sound, movement, and optical or magnetic signals, portable and lightweight sensors are perpetually in demand in consumer electronics, biomedical engineering, military applications, and wide range of other sectors. However, despite extensive existing developments in computing and communications for integrated microsystems, we are only just now seeing real transformational changes in sensors, which are critical to conducting so many advanced integrated tasks.

This book is designed in parts – Optical and Acoustic Sensors and Magnetic and Mechanical Sensors – that address the latest development in sensors.

The first part covers:

- Optical and acoustic sensors, particularly those based on polymer optical fibres
- Potential thermometry and solar cell analyses
- Description of research from United States Army Research Laboratory on sensing applications
- Advance in the design of underwater acoustic modems.

The second discusses:

- Magnetic and mechanical sensors, starting with coverage of magnetic field scanning
- Some contributors' personal accomplishments in combining MEMS and CMOS technologies for artificial microsystems used to sense airflow, temperature and humidity
- MEMS-based micro hot-plate devices
- Vibration energy harvesting with piezoelectric MEMS
- Self-powered wireless sensing.

As sensors inevitably become omnipresent elements in most aspects of everyday life, this book assesses their massive potential in the development of interfacing applications for various areas of product design and sciences – including electronics, photonics, mechanics, chemistry, and biology, to name just a few.

11 Smart Sensors for Industrial Applications

by: Krzysztof Iniewski

Published 2013

**by CRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway
NW, Suite 300, Boca Raton, FL 33487-2742, USA, 562pp**

ISBN 978-1-4665-6810-5 (Hardback)

Sensor technologies are a rapidly growing area of interest in science and product design, embracing developments in electronics, photonics, mechanics, chemistry, and biology. Their presence is widespread in everyday life, where they are used to sense sound, movement, and optical or magnetic signals. The demand for portable and lightweight sensors is relentless in several industries, from consumer electronics to biomedical engineering to the military. *Smart Sensors for Industrial Applications* brings together the latest research in smart sensors technology and exposes the reader to myriad applications that this technology has been enabled.

Organised into five parts, the book explores:

- Photonics and optoelectronics sensors, including developments in optical fibres, Brillouin detection, and Doppler effect analysis. Chapter also look at key applications such as oxygen detection, directional discrimination and optical sensing.
- Infrared and thermal sensors, such as Bragg gratings, thin films, and microbolometers. Contributors also cover temperature measurements in industrial conditions, including sensing inside explosions.
- Magnetic and inductive sensors, including magnetometers, inductive coupling, and ferro-fluidics. The book also discusses magnetic field and inductive current measurements in various industrial conditions, such as on airplanes.

- Sound and ultrasound sensors, including underwater acoustic modem, vibrational spectroscopy, and photoacoustics.
- Piezoresistive, wireless, and electrical sensors, with applications in health monitoring, agro-food and other industries.

Featuring contributions by experts from around the world, this book offers a comprehensive review of the groundbreaking technologies and the latest applications and trends in the field of smart sensors.