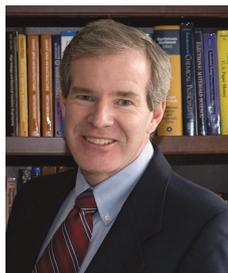


## BOOK REVIEWS



by *John J. Shea*

### High Power Microwave Tubes—Basics and Trends

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<http://www.morganclaypool.com>  
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(volume 2, \$49, softcover, 2018)

The *IOP Concise Physics* series of books are short texts that provide readers with an introduction to key principles of current research topics. These books are aimed at researchers and students of all levels with an interest in physics and related subjects.

This two-volume set introduces the fundamentals of high power microwave tubes. Volume 1 focuses on the operation and basic principles of microwave tubes, and volume 2 provides details on various types of high power microwave tubes commonly used today.

Volume 1 contains five chapters. Chapter 1 begins with a historical perspective of electron tubes and microwave tubes (MWT), including limitations of frequency response and how many of these limitations are overcome. Chapters 2 and 3 outline the classification of

MWTs and the various uses of each type of MWT for military, medical, scientific, and industrial applications. Chapter 4 focuses on the basic concept of electron guns—the Pierce gun made from a flat or curved cathode surface for O-type tubes and a cusp-shaped gun surface for small-orbit and large-orbit gyro-tubes. Also discussed are the traditional magnetic focusing structures for electron beam confinement. Chapter 5 presents an analysis of helical slow-wave structures along with optimization methods to obtain the desired dispersion characteristics for increased wideband performance.

Volume 2 also contains five chapters that continue from volume 1. They cover specific MWT types. Chapter 6 covers conventional MWT (i.e., traveling-wave tubes, klystrons, and crossed-field tubes). Chapter 7 provides details on the operating principles of fast-wave tubes, including the cyclotron resonance maser, gyrotron, gyro-klystron, slow-wave cyclotron amplifier, and peniotron. Chapter 8 contains the operating principles of vacuum microelectronic tubes and the principles of vacuum microelectronic technology. Devices that are discussed include plasma-filled tubes, relativistic MWTs, high-power Cerenkov tubes, and Vircator tubes. The last two chapters contain information on frequency and power ranges of common microwave tubes and trends and future directions for MWTs.

With very few new books on microwave tubes being written, this set provides a fresh introduction to microwave tubes for interested students and professionals who want to learn more about traditional microwave technology. Its concise format provides for a quick understanding of the material being presented, and the references provided allow for further, more in-depth study as desired. These volumes will give the reader a good basic understanding of traditional microwave tube technology, which still dominates in high-power applications, even with the many advances in solid-state technology.

### A-Level Chemistry's Best Kept Secrets!—What Top Students Know That You Don't

D. Tan and L. Pereira  
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<http://www.worldscientificpress.com>  
ISBN 978-981-3220-12-6  
223 pp., \$35 (softcover), 2018

Although A-level standards for courses are used in the UK, this book is still an excellent reference for students studying chemistry basics. In the UK, the A-level chemistry syllabus is based on an understanding of a broad range of topics in chemistry that includes physical, organic, and inorganic chemistry. This book can be used as a supplementary text for A-level chemistry courses or in an advanced high school class or a first-year college chemistry class.

It consists of three sections—General and Physical Chemistry, Inorganic Chemistry, and Organic Chemistry. The first section covers fundamental topics ranging from atomic structure, chemical bonding, chemical energetics, equilibria equations, and reaction kinetics. The next section, inorganic chemistry, covers chemical periodicity, Group II and Group VII elements, and transition elements. The third section, organic chemistry, describes structure and bonding fundamentals, introduces isomerism, hydrocarbons, halogen derivatives, hydroxy compounds, carbonyl compounds, and nitrogen compounds.

This book will help the reader make connections between the different branch-

es of chemistry. Along with the theory, there are examples of recent technology applications used to help reinforce the theory being presented. One example in electrochemistry shows how to determine the reaction equations for a modern fuel cell. Many other examples show sketches of practical experimental setups used to illustrate the theory being presented. Rather than only present equations and theory, the authors put a lot of effort into ensuring the reader will gain a better understanding of the concepts being presented through the use of examples, applications, illustrations, and experiments. There are also general trends, rules of thumb, common mistakes, and practical explanations for each topic.

If you know someone studying chemistry or you just want to brush-up on basic chemistry, then this book is an excellent way to quickly understand many fundamental concepts in three broad areas of chemistry.

## **An Introduction to Chemical Kinetics**

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79 pp., 39.91euro (softcover), 2017

The *IOP Concise Physics* series of books are short texts that provide readers with an introduction to key principles and current research topics. These books are aimed at researchers and students of all levels with an interest in physics and related subjects.

This book is an introduction to the main principles of chemical kinetics. It originated from a set of lecture notes from a core first-year lecture course in physical chemistry taught by the author at the University of Oxford. It provides a concise introduction to a key principle in chemical kinetics that includes elementary reactions, collision theory, rate laws, and reaction mechanisms. It also includes

experimental methods and data analysis techniques for obtaining chemical kinetics over broad timescales.

After introducing elementary chemical reactions, rate laws are covered. These relate the reaction rate to reactant concentrations, an important fundamental concept to understand. The book continues with methods for experimentally obtaining reaction rate quantities. These include the various methods used to experimentally determine reaction rate order, rate constants, and monitoring concentrations as a function of time. There is also an introduction to complex reactions with a method to derive rate laws for complex reactions. The final chapter introduces the theory behind chemical explosions and the reactions necessary for an explosion to occur (or not to occur). One reason for measuring reaction rate constants is that they are used in the Arrhenius equation, which is very commonly used to model chemical reactions over a valid temperature range.

The concise and focused nature of this book on a single topic makes it very readable. You will quickly grasp the fundamental principles and obtain a good working knowledge of the subject matter in this short book. Chemical kinetics is a stepping stone for many other processes and technology areas, especially in chemistry, vacuum science, and plasma physics. This is an outstanding review of a key topic in chemistry.

## **Control of Power Electronic Converters and Systems, Volume 1**

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Power electronic converters are used in a variety of systems for controlling and conditioning electrical power. They are used to change voltage levels, control frequency and power to a motor, convert

DC to AC in photovoltaic arrays, and even allow for the bi-directional control of power flow in a microgrid. These devices have received great attention lately due to the increasing use of wideband gap semiconductors. Wideband gap semiconductors enable greater efficiency, higher operating temperatures, and higher voltages as compared with traditional silicon-based components.

This book delves deeply into the inner workings of a wide variety of power electronic converters. It starts out by introducing the fundamental topologies of converters—voltage source and current source—and explains the differences; typical application; benefits and disadvantages of AC/DC, DC/AC, DC/DC, and AC/AC converters. This sets the foundation for future chapters, which dive into the control theory for each type of converter for various applications. Basic analog and digital control principles are introduced before specific types are discussed. This introductory material focuses on the use of control targets and pulse width modulation methods in converter design. This sets the foundation for the reader to understand more in-depth control methods used for each type of converter.

The control and modeling methods reviewed cover DC/DC, single-phase and three-phase AC/DC including phase-locked loops, single- and three-phase DC/AC, and AC/AC converters. Fundamental designs for each circuit are described in detail along with modulation techniques and control strategies. The reader will gain an in-depth understanding of control designs and control strategies for each type of converter. The book continues with the design and control of voltage source converters with LCL-filters, used to reduce the high inductance that would otherwise be present if a traditional L-filter was used. This continues with the modeling and control of photovoltaic systems and wind turbine systems. There are some details given on bypass diodes for sub-strings in photovoltaic arrays and methods of maximum power-point tracking. The final part of the book describes adjustable-speed drives, including the principle operation of induction motors and permanent magnet synchronous motors and the control methods used in

drives for these motor types. Further, sensorless control of motor drives is also described, involving control at ultralow speeds and high speeds, high-frequency signal injection-based control and back EMF control of permanent magnetic synchronous machines.

Those interested in power electronic converters and variable speed drives will find this book very useful for understanding the fundamental topologies, circuit design, and control methodologies of these systems.

## Wireless Sensor Systems for Extreme Environments

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The use of wireless sensing technology is rapidly growing, and the use of wireless technology in extreme environments is enabling new applications. Today, data from locations previously inaccessible with networked sensors can now be collected with a shared data environment that can be used to monitor complex systems for sensing abnormalities and act to allow for predictive maintenance or action, thereby preventing disasters or unplanned down time.

This book details the most current, state-of-the-art methods used in wireless technology for extreme application environments. It consists of five parts. Part I covers an overview of general methods used for wireless sensing in extreme environments. It begins with a very nice abstract describing each chapter, giving the reader a very good overview of the details so the reader can quickly determine whether they want to read that chapter. After these summaries, the remainder of Part I describes fundamental methods used in wireless sensing technology. This provides the reader, who may be unfamiliar with the latest methods, a basic understanding of this technology and many of

the difficult key issues. These methods cover feedback and control, optimization of power consumption to extend life, connectivity schemes (multi-hop methods), rare-event sensing, and event powered sensors.

The remaining four parts each cover a specific harsh environment for wireless sensing applications, starting with Part II—Space applications. This very extreme environment explores battery-less sensors and disruption-tolerance networks to enhance the performance of Earth observation missions, especially if some data experience more delay than others. Other areas include a complete sensor-node system from design to implementation and test for space launch vehicles. The robustness of adaptive networks to changes in the environment, topology or traffic, with centralized and distributed methods are discussed. Architecture details of sensor nodes and systems are also covered including A-to-D converters, DSP cores, ARM processors and wireless radio communications, and new applications for near space (20–100 km altitudes).

Part III investigates underwater acoustic sensing. It begins by introducing the reader to underwater networked sensors, their limitations, and potential applications. A wide range of various communication methods and recent advances are presented. Some of the specific communication methods discussed are underwater anchor localization using surface reflected beams and coordinate mapping methods. Security issues are also reviewed.

Part IV discusses underground and confined environments in general and specifically for agricultural applications. It details a magnetic induction-based sensor system for underground application as well as other specific technical considerations for agricultural applications.

Part V covers industrial applications. These include structural health monitoring (e.g., bridges and other structures), RFID technology, power harvesting, and stress sensing using optical fibers. Other areas of wireless sensing cover aircraft and off-shore wind-farm monitoring, with fault detection being the main topic for wind applications.

This book is a valuable resource for researchers, graduate students, and en-

gineers who design and build wireless communication networks and sensors for control systems, emergency response systems, and other monitoring systems for predictive maintenance in extreme environments.

## Transformer Aging—Monitoring and Estimation Techniques

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<http://www.wiley.com>  
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An oil-filled power transformer begins to degrade the moment it is constructed and put into service. The insulation system degrades and this degradation rate depends on the operating conditions of the transformer. Thermal, oxidation, and hydrolytic processes are the main causes of aging. Over the years, there have been numerous methods developed to assess the condition of the insulation system in a transformer. Typically, these were off-line sampling of the oil, such as a dissolved gas analysis, or other tests that required post-processing. These spot checks of transformer condition over a period of time do not provide a continuous monitoring of the transformer condition. More recently, there have been in situ methods developed to constantly monitor insulation condition. These methods may provide better predictive assessment of the transformer insulation and 24/7 monitoring that can alert an operator if a transformer needs maintenance. One of the most undesired events is an unplanned failure of a large power transformer. Regular spot-check sampling or continuous monitoring or both are essential to ensure transformer integrity, reliability, and long life.

This book describes the important aspects of transformer insulation from an aging perspective. It contains 10 chapters. Chapter 1 describes the properties

and applications of insulating materials in oil-filled power transformers, including an overview of aging of oil–paper insulation systems.

Chapter 2 comprehensively explains various diagnostic methods that cover the dissolved-gas analysis, furan analysis, and degree of polymerization. Other measurement indicators described are insulation resistance, polarization index, dielectric dissipation factor, capacitance, power factor, dispersion factor, and partial discharge (PD).

Chapter 3 details the theoretical explanations of polarization–depolarization current, recovery voltage measurements, and frequency domain dielectric spectroscopy including interpretation of results. Effects of moisture on these parameters are also described.

Chapter 4 reviews commonly used interpretation techniques for dissolved-gas analysis, with machine-based learning, neural network analysis methods, and the various algorithms associated with these methods.

Chapter 5 covers a detailed analysis of PD measurement methods and interpretation tools for transformer condition monitoring. Wavelet analysis and other advanced analysis methods are used to interpret PD signals. Feature extraction and waveform recognition are also discussed in this chapter.

Chapter 6 focuses on frequency response analysis for mechanical deformation/displacement of transformer windings.

Chapter 7 explains on-line moisture measurement sensors. These are used to predict the remaining life of insulation as a function of the water content of the insulating paper.

Chapter 8 presents the fundamentals of biodegradable oil and their effect on paper insulation aging. Chemical and physical measurements and polarization–depolarization current and frequency domain dielectric spectroscopy interpretation schemes for biodegradable oils are pre-

sented, along with a comparison with currently used condition monitoring methods used for mineral oils.

Chapter 9 details a methodology for transformer condition monitoring using on-line sensors. It also describes the use of numerical modeling to assist in interpreting sensor outputs, how to deal with statistical variance and measurement uncertainty, and how to combine sensor outputs to arrive at an overall condition assessment for the transformer “health.”

Chapter 10 highlights limitations of the present transformer condition methods and indicates areas that need further research and development.

This book is an excellent resource for engineers, teachers, and researchers interested in learning about the degradation processes and condition monitoring methods for insulation systems in oil-filled power transformers. It provides a very good introduction and background to the issue of condition monitoring and reviews many of the major methods used to assess the condition of these transformers. This type of information was, up until this point, scattered throughout many journal and conference papers. This book provides one convenient source for all this research. It also provides insight into the future needs for further development of condition monitoring methods and sensors.

## Quantum Field Theory

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In theoretical physics, quantum field theory is the theoretical framework for constructing quantum mechanical models of subatomic particles in particle physics and quasiparticles in condensed matter physics. It is a set of equations and mathematical tools that combine classical fields, special relativity, and quantum mechanics.

This book describes the dynamics of electrons and quarks as described by the Standard model of particle physics. After detailing classical mechanics and relativistic mechanics, the general framework of quantum field theory is described. Quantization of scalar fields, spinor fields, and vector fields is described. Perturbation theory and symmetry concepts are introduced. Basic particle interactions are described by gauge theories, which discuss quantum electrodynamics and quantum chromodynamics. Both electromagnetic and weak interactions are used in the gauge theory descriptions. Grand Unification theory is discussed in light of new progress in gauge theories.

This book is for readers interested in quantum field theory who already have a good background in quantum mechanics. Although most of the mathematics presented consist of matrix math, integrals, curls, and partial derivatives, many of the discussions require some working knowledge of the concepts being described to fully appreciate the book.

