*Laser and Particle Beams* (2000), *18*, 715–721. Printed in the USA.


# Book Reviews

**Title:** ***$CO_2$ Laser Cutting, 2nd Edition***
**Author:** John Powell
**Publisher:** Springer-Verlag
**Year:** 1998
**Pages:** 248
**Price:** $79.95
**ISBN:** 1-852-33047-3

This book treats the most widespread application of high-power laser materials processing, that is, $CO_2$ laser cutting. Although called $CO_2$ laser cutting, most of the content of the book is also valid for cutting with other lasers such as Nd:YAG or Cu Vapor lasers. The technology is described in a very useful style by emphasizing practical aspects and by replacing highly scientific phrases by clear, illustrative explanations. Nevertheless, this guide through the complex field of laser cutting is accompanied by critical physical explanations throughout the whole book. It should be emphasized that Dr. Powell is the technical director of two job shops on laser cutting, but has also been highly active in science for many years. This ideal combination of practical experience with scientific know-how is reflected throughout the whole book by highlighting the practical aspects of laser cutting, often accompanied by very critical scientific explanations. It should be noted that the present second edition of the book differs from the first edition, printed in 1993, only by several pages that had to be updated according to the state of the art.

The 11 chapters of the book can be divided into 5 characteristic parts. A chapter on basic principles introduces the reader to the whole task of laser cutting. In the following three chapters the mechanism of laser cutting and its characteristic behavior are described with respect to three classes of materials, steels, nonferrous metals, and nonmetals. In the subsequent three chapters on setting up of laser cutting, on troubleshooting, and on laser safety, practical aspects for operating a laser system are dealt with. One chapter compares laser cutting with alternative cutting methods with respect to quality, performance, and costs. Finally, chapters on a more scientific level explain in more detail the $CO_2$ laser source as well as the cutting process, accompanied by a survey on literature.

In the first chapter of the book the reader is introduced to the basic principles upon which the laser cutting process relies. Initially, the fundamental mechanism of the laser cutting process is shortly described and a typical laser cutting nozzle is shown in order to illustrate the process from the beginning. Based on this, the advantages of laser cutting compared to competing cutting techniques are discussed, which emphasize the superiority of this technology. Subsequently, the basic physical mechanism of the $CO_2$ laser source is briefly described in a very illustrative manner, suitable also for readers not experienced in laser technology. Here also, the different modes of the intensity distribution of a laser beam are under consideration.

The following chapters treat the laser cutting process by discussing the physical mechanisms, the parameter dependencies, and various relevant practical aspects. These chapters are divided with respect to the material types to be cut, that is, steels, nonferrous metals and nonmetals are distinguished.

The chapter on laser cutting of mild steel, being the most important laser cutting application, is typical for the style of the whole book. Many practical aspects that can be very useful for any operator of a laser cutting system can be found. In particular the author succeeded in providing simple rules of thumb for the parameter dependencies of the process, although the parameter behavior is by far not completely understood to date due to the high complexity of the physical mechanisms and due to the large number of process parameters. Examples are quantitative estimation like "1.5 kW of laser power will cut 1 mm thick mild steel at 10 m/min and 10 mm thick steel at 1 m/min . . ." or qualitative rules like an indicative trend for the most suitable nozzle exit diameter and O gas pressure in dependence of the sheet thickness, added to a conventional speed-*versus*-thickness diagram. Because they are simple and clear, once read, the reader will ever bear in mind these general rules. Beside the typical parameter dependencies such as the basic beam or gas jet parameters, many additional sources of influence on the process are mentioned, such as surface finish of the workpiece, cut initiation and termination, cutting of corners, misalignment of the nozzle, etc.

Beside these practical aspects, however, the chapter on laser cutting of mild steel also demonstrates the second characteristic feature of the book style. Whenever possible, the author tries to explain the process behavior by its basic physical mechanism, again in a very illustrative manner by avoiding complex formulas. For instance, the mechanism of oxidation during O cutting of mild steel is explained and discussed with respect to its influence on the cutting behavior, for example, "it will be seen later

that this input–output energy balance is responsible for the fact that too much or too little oxygen flow can both cause unwanted burning . . . .” Thus, a problem known from practice is briefly discussed in this chapter and treated in more detail in a final, more scientific section of the book.

Besides mild steel, different alloyed steels are dealt with. Here the importance of the formation of different oxides as a crucial phenomenon is highlighted. Typical industrial applications of parts to be cut illustrate the importance of laser cutting of specific steel alloys. In the chapter on laser cutting of nonferrous metals Al and Ti alloys are discussed with respect to specific phenomena related to these metals. Moreover, Ni and Cu alloys are mentioned.

The section on laser cutting of nonmetals encompasses cutting of polymers, wood-based products, ceramics, glasses, and composite materials. Here the author demonstrates his excellent physical know-how and understanding of the process mechanisms and his highly critical analysis of the processes, often based on his own research work. Particularly the mechanism of laser cutting of nonmetals has not been completely understood to date and leads to wrong interpretations. While in literature, the cutting of nonmetals is often simply called sublimation cutting or cutting by vaporization, the present book distinguishes between melt shearing, vaporization, and chemical degradation. Probably surprising for the reader, vaporization only takes place for two particular materials (acrylic glass and polyacetal), while melt shearing or chemical degradation are the dominant mechanisms. Again, the mechanisms are clearly illustrated by avoiding complex scientific descriptions. Many practical tips can be found and optimum process parameters are recommended. A very simple mathematical model has been accomplished that enables us to predict the achievable cutting speed, based on one single experimental result.

Throughout the whole book, various innovative approaches can be found, such as adding water to the process, employing a dross jet nozzle below the workpiece, or the scribing of ceramics with subsequent breaking.

While the process mechanism and the corresponding parameter behavior are discussed for the most relevant materials in the chapters on laser cutting of steels, nonferrous metals and nonmetals, the following chapters comprise various practical methods that are useful for operators on laser cutting systems. These are setting up for cutting, troubleshooting, and safety guidelines. These chapters can be regarded as a very useful extension of purely scientific books, since these tasks can rarely be found in other published work.

Useful setup methods for laser cutting in order to align the laser beam and the nozzle are often missing in common books, since they are not relevant for science and engineering; they are, however, of particular importance for the operator in daily life. John Powell introduces the reader to efficient methods like beam prints, alignment cross wires, HeNe-alignment lasers, etc. Different methods are discussed by identifying their specific advantages. While these methods for setting up a laser are of high interest for new or potential laser users still not experienced in the field, experienced operators will also find new methods and aspects which are sometimes not obvious. For example, finding the focal plane location of the focused beam is an essential task for providing a good laser cut. In the present book, the blue flash test and the drilling test are explained. Nozzle alignment and choice of the best processing head are treated in a thorough manner. Here the author again took the opportunity to disseminate his excellent physical know-how by introducing the reader to the complex fluid mechanical mechanism of the process gas jet that is transsonic in nature. This is a highly complicated task that is often misunderstood, since the creation of a partially supersonic flow from a conical nozzle is by far not obvious, except for fluid-mechanical engineers. Jigging the workpiece, tuning the laser resonator, and aligning the laser beam are further practical tasks that complete this chapter on setting up the laser.

In the chapter on troubleshooting, the different components of a laser cutting system and their corresponding parameters are systematically treated through use of a checklist. Rules for avoiding bad quality of the cut surface are stated and tips for supervising and cleaning the focusing optics and the process gas nozzle are given.

Moreover, $CO_2$ laser cutting is compared with alternative cutting methods. Concerning laser cutting, a comparison between $CO_2$ and Nd:YAG lasers is carried out, which particularly focuses on absorption behavior, beam focusing, and pulsing capabilities. Economic importance is discussed in the comparison of laser cutting with conventional methods, particularly with plasma-arc cutting, abrasive water-jet cutting, and oxygen-flame cutting. The different techniques are briefly explained and the differences in achievable cut quality, limitations, performance, and costs are discussed.

The final chapters are on a more scientific level, thus of particular interest for readers who are interested in the physical background of the subject in more detail. These chapters outline results published by the author. In contrast to the introductory chapter, the excitation of a $CO_2$ laser and the specific role of the different laser gases is described. Concerning the process, an energy balance is stated that permits a rough analysis of the process. Of particular interest is the basic mechanism of oxidation during steel cutting, where the amount of oxidation is estimated experimentally, both for mild and stainless steel. Further energetic estimations observed from experiments are given for conductive, reflective, and transmitted losses. In addition, practical limits on beam focusing are discussed. The chapter is followed by a comprehensive survey on literature that also provides information on relevant conferences and journals in general.

It can be concluded that John Powell’s book on $CO_2$ laser cutting is an excellently written book that is highly useful for the operator, since it is close to practice. However, the book also provides many interesting aspects on a scientific level. The book is written in an unconventional manner, since it is very illustrative and with clear, practical aspects, which permits a very refreshing, unconventional way of reading.

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The technique of laser cutting is well described for the many different materials to be cut by a laser. The process mechanisms can be well understood since they are clearly illustrated and explained by basic physics. Because of its stating of typical values for the different process parameters, the reader always has the impression that he can directly make use of the content. The reader benefits from many practical tips that are very useful for laser cutting.

Consequently, the book *$CO_2$ Laser Cutting* can be recommended to appliers of laser cutting as well as to potential users and also to researchers.

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**Alexander F.H. Kaplan** was born in Vienna, Austria on the 18th of December 1967. He studied electrical engineering at the Vienna University of Technology where he graduated in 1990 after completing his diploma thesis on analysis of new flashlamps for Nd:YAG lasers. He has been with the Department of Laser Technology (headed by Professor Dieter Schuöcker) at the Vienna University of Technology since 1989, where he is the head of a group on European projects in association with the EuroLaser Academy. In 1994, he completed his dissertation thesis on mathematical modeling of deep penetration laser welding. His research activities comprise mathematical modeling of laser materials processing, where he is the chairman of the corresponding European working group. He has published models on laser welding, cutting, and surface treatment. He is currently working on his docent's thesis on laser beam cutting.

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| **Title:** | ***Atom–Photon Interactions: Basic Processes and Applications*** |
| **Author:** | Claude Cohen-Tannoudji, Jacques Dupont-Rock, & Gilbert Grynberg |
| **Publisher:** | John Wiley & Sons, Inc. (New York) |
| **Year:** | 1992; paperback edition issued in 1998 |
| **Pages:** | 656 |
| **Price:** | $44.95 |
| **ISBN:** | 0-471-29336-9 |

When this remarkable book appeared in 1992, it became an instant classic. Combined with its precursor volume by the same authors, *Photons and Atoms: An Introduction to Quantum Electrodynamics*, these works deftly illuminate the central interactions between light and matter. I refer the reader to the excellent review of *Atom–Photon Interactions: Basic Processes and Applications* by T.A. Brian Kennedy (*American Journal of Physics 61*(6), 1993, p. 572).

The book is organized into 6 chapters that elegantly develop and summarize the theory, and 14 complements that expand on various aspects of the theory or give additional illustrations. There are 20 exercises, each with a detailed solution, that provide even more applications of the theory. A brief tour through the chapter topics follows:

Transition amplitudes are introduced in Chapter 1 via the evolution operator. Perturbation theory is used to approximate matrix elements of the evolution operator between initial and final states. The authors highlight the behavior of systems where the initial and final states are discrete or are part of a continuum. They also introduce a diagramatic representation of transition amplitudes for the study of electrodynamics.

Chapter 2 presents an overview of the fundamental ways in which atoms and photons act upon each other. Emission, absorption, scattering, and multiphoton situations are treated. Photoionization, bremsstralung, and photodissociation are studied by considering initial and final states of the system that are continuous. The effect of the spectral nature of the radiation field is considered, *via* correlation functions. Complement A contains a conceptual model of both broadband and narrowband light detectors.

The resolvent formalism is fully developed in Chapter 3. This method allows some phenomena to be calculated to all orders in the coupling between the atom and field. Contour integration is a central mathematical tool for this approach, and the authors carefully explain the analytic properties of the resolvent operator. Spontaneous emission (both the decay and shift of states), spectral distribution of emitted radiation, and radiative cascades are among the topics investigated. The transition studied in the historic Lamb Shift furnishes an example of indirect coupling between a discrete state and a continuum.

The electromagnetic field is considered as a reservoir in Chapter 4. The evolution of atoms is damped by coupling to the reservoir. The authors provide a careful justification and generalization of Einstein's rate equations. The master equation is derived and applied to atomic excitation by radiation with both broad and narrow spectral widths. The method is examined in the case of a damped harmonic oscillator.

In Chapter 5, the optical Block equations are derived. These are applicable to atoms subjected to monochromatic light of high intensity. The spectral characteristics of the fluorescence are considered. The authors carefully compare this approach with other methods.

Chapter 6 contains a grand description of the dressed-atom viewpoint. Perhaps more than any other technique, this method embodies the quantum nature of the atom and the electromagnetic field in a stunningly visual presentation. Energy level diagrams refer to the total energy of the atom-field system, and the effects of the coupling can be drawn almost intuitively. Many significant phenomena of atomic physics are explained with incredible clarity, including the Block–Siegert effect (what the "counter-rotating term" does to the resonance characteristics), the Autler–Townes effect, the effects of collisions on emission spectra, and forces exerted on atoms by light.

The authors recommend Chapters 1, 2, and 5, along with section A of Chapter 4 for a simple first look at the material. I would also add the appendix to this list, as it provides a brief exposition of the way in which electrodynamics is used here.

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The writing is clear. There are a few places where the translation from French seems awkward, such as referring to the interaction picture as the "interaction representation," or a dark state as a "black state." In the introduction, the solutions of the exercises are called "corrections." But these items are, at worst, distracting, and at best, entertaining.

The level of the book seems appropriate for graduate students and researchers interested in atom–photon interactions. The authors intend that each chapter be self-contained, so that it can be read independently of the others. In some spots, I found it difficult to follow the arguments in detail, but there was always a notation to the appropriate section in the book, or to another reference. The authors carefully motivate what they are attempting to accomplish in every section. Sometimes they present order-of-magnitude arguments to identify the most important effects. Still, it was tough going for me. Even in the first chapter, there are equations that I cannot derive because I am unable to sort out what assumptions have been made. I suspect that these difficulties reflect my own limitations in theoretical physics.

As an experimentalist, I had hoped to find some details on how to handle "real" atoms interacting with photons from "real" sources. If light from an infrared diode laser passes through a cell containing rubidium vapor, issues such as optical pumping of the hyperfine levels, transit-time broadening, off-resonant excitation, and energy-changing collisions cannot be ignored. Exercise 20 brilliantly introduces and develops the concepts behind the method of saturated absorption, including the effects of collisions, for two-level atoms. And, of course, the authors could write an entire book on the cooling and trapping of atoms, though they do derive the forces that atoms experience when subjected to laser light, and the subsequent modification of the atomic velocity distribution.

The way in which light interacts with matter is a venerable subject, and several other books deal with similar material. The present work is unique in its beginning from the foundations of quantum mechanics, its exposition of the theory in terms of several examples from multiple points of view, and in its inclusion of dressed atoms. Here is a list of other texts that I have found useful:

Alan Corney, *Atomic and Laser Spectroscopy*, Oxford University Press, Oxford, 1977. ISBN 0-19-851148-5
Rodney Loudon, *The Quantum Theory of Light*, Second Edition, Oxford University Press, Oxford, 1983. ISBN 0-19-851155-8
William Louisell, *Quantum Statistical Properties of Radiation*, Wiley, New York, 1973. ISBN 0-471-52365-8
Marlan Scully and M.S. Zubairy, *Quantum Optics*, Cambridge University Press, Cambridge, 1997. ISBN 0-521-43595-1
Mitchell Weissbluth, *Atoms and Molecules*, Second Edition, Academic Press, New York, 1978. ISBN 0-12-744452-1
Mitchell Weissbluth, *Photon–Atom Interactions*, Academic Press, Boston, 1989. ISBN 0-12-743660-X

It is wonderful that the publisher has issued this paperback edition, because it is substantially more affordable than the hardcover version ($116.00). The companion volume, *Atoms and Photons: Introduction to Quantum Electrodynamics*, is also available in paperback ($44.95) and hardcover ($123.00) forms. But I wonder why hardcover editions cost so much more than paperback editions. I am also concerned about the life expectancy of the paperbacks. Although I am confident that these paperback editions are carefully made of quality materials, the tattered condition of my two-volume paperback quantum-mechanics text coauthored by Cohen-Tannoudji demonstrates that I refer to it often and that a hardcover edition would be desirable.

In summary, *Atom–Photon Interactions: Basic Processes and Applications* is a superb book. The reader may already own it. Now the reader's students can afford it.

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**Michael M. Kash** earned his Ph.D. at the Massachusetts Institute of Technology. He is Associate Professor of Physics and department chairperson at Lake Forest College. His research interests involve experimental aspects of atomic physics, lasers, and quantum optics.

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| **Title:** | ***A Guide to Experiments in Quantum Optics*** |
| **Author:** | Hans-Albert Bachor |
| **Publisher:** | John Wiley & Sons, Inc. (New York) |
| **Year:** | 1998 |
| **Pages:** | 378 |
| **Price:** | $95.00 |
| **ISBN:** | 3-527-29298-5 |

This book succeeds in providing an experimentalist's view of quantum optics, complementing the many standard texts which take a theoretical point of view (see, e.g., M.O. Scully and M.S. Zubairy *Quantum Optics*, Cambridge University Press, 1997). As the title indicates, the book focuses mainly on experimental efforts and the realistic conditions of experimental tests. The choice of topics was clearly the result of the author's experience in the field of experimental quantum optics and a solid understanding of the pedagogical requirements of the material.

The author's straightforward style is well suited to the material and serves the interest of experienced practitioners and newcomers to quantum optics alike. The book's emphasis on the close relationship between nonlinear and quantum optics is particularly helpful to the researcher, since this link is often buried in the standard approach to the quantum formalism. The quantum mechanical treatment of basic optical components such as beam splitters and cavities establishes a rigorous connection between the quantum states of light and the experimental properties of the apparatus that operate on these states.

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A distinct strength of the book is the detailed analysis of noise features for optical radiation in different contexts. The introduction to sidebands is well suited to readers with an engineering background; however, it would not be suitable as a first source on sidebands for a more general audience. The bibliography after each chapter makes each section self-contained and will be particularly helpful for graduate students involved in different types of quantum optics research.

A more thorough introduction to the theory of lasers would suit this valuable collection of experimental descriptions. Specifically, the entire discussion of ultrafast optics seems limited to Q-switching, leaving out the very popular femtosecond systems.

The fundamentals of quantum optical state preparation and photon flux detection are followed by a description of experimental efforts to test some counterintuitive features of quantum theory such as the Einstein-Podolsky-Rosen effect. This topic has historically served as the main engine for the development of quantum optics. The sections on quantum cryptography, quantum properties of squeezed light, and experimental efforts to measure gravitational waves provide adequate introduction to these exciting applications of quantum optics. Furthermore, the treatment of the spatial properties of squeezed light is very relevant, considering the growing interest in quantum imaging.

This book focuses to a large extent on the experimental situations that involve continuous variables, such as quantum nondemolition experiments and squeezed states. The relatively reduced focus on photon number and time-of-arrival experiments betrays the increasing importance of these aspects of quantum optics in the generation and practical use of single-photon and entangled-photon states. A more thorough discussion of the new experimental approaches and photodetection techniques necessary for these pursuits would compliment the solid presentation of the continuous variable case.

In conclusion, except for several minor technical problems, this book is a nice collection of the milestone experiments that have defined recent progress in the quantum optics of squeezed states. The book is suitable for quantum optics researchers or curious readers with a college level background in quantum mechanics.

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**Alexander Sergienko** is an Assistant Professor in the Department of Electrical and Computer Engineering and Photonics Center at Boston University. His research interests include experimental study of basic concepts of quantum mechanics and development of new experimental optical measurement techniques based on quantum principles. These new quantum techniques usually either outperform their classical counterparts or do not have any classical analogues at all. His recent projects include nonstationary quantum optics with ultrafast laser sources, quantum cryptography using entangled photons, characterization of polarization mode dispersion in optical and photonics materials, and infrared radiometry without infrared detectors.

**Title:** ***Laser-Assisted Microtechnology, 2nd Edition***
**Author:** S.M. Metev & V.P. Veiko
**Publisher:** Springer Verlag (Berlin, New York)
**Year:** 1998
**Pages:** 270
**Price:** $69.95
**ISBN:** 3-540-63973-X

This monograph, updated from the first edition of 1994, is a thorough and timely addition to the increasing set of texts on microsystems technology (MST). It is valuable since it concentrates on a vital area of development—laser MST techniques—and presents a detailed overview of many of the applications areas in this rapidly expanding field.

A brief description is given in Chapter 2 of some lasers and laser systems needed for laser processing and where particular lasers are of most benefit. One omission from this treatment, and in fact from the entire monograph, is that of *projection* techniques; all the work presented is based on some form of focused laser beam interactions. This omission for an increasingly relevant technique in many industrial applications of lasers (e.g., DUV lithography, large-area laser engraving, production of laser etched multilevel devices, etc.) is to be regretted, but it does not impact on the treatment of the other applications that are presented elsewhere.

Other chapters deal with the machining of thin films, heat treatment, microwelding, microshaping, micropatterning, and deposition techniques. The approach that has been taken by the authors is to start each section with a physical or physicochemical treatment of the process being addressed to lay the groundwork of theory governing the area. This is handled in some detail in most sections and includes theoretical models (e.g., for laser-induced heat treatment or laser machining of thin films) to describe the processes. Representative data is also included throughout each section that highlights important properties that have been presented. For example, in the section on laser welding, a comparison is given for different welding regimes in various metals that shows the weld strengths *versus* weld geometries/processing conditions, and in the section on hole drilling, the size and aspect ratio of holes in materials are given for different laser parameters.

On the whole, the details provided for individual applications are excellent and give the necessary context in which the applications have developed. Extensive details are also provided for specific processes, and, thus, a clear picture can be built up of the developments in a particular field.

In the preface to the new edition, the authors mention that one of the drawbacks to the rapid advancement of this field is the lack of "suitable technological methods for three-dimensional (3D) treatments of microparts." This, however, is not treated in the book, but it is an important area of laser micromachining. In the opinion of this reviewer, the book would become a far more complete text if it were to include some details of laser processing of 3D structures as well.

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The difficulty with any book of this type is always that the pace of change in fields such as lasers is so great that no book can hope to cover all areas of interest or be up-to-date for very long. The approach that the authors have taken with this particular book largely deals with these problems, albeit over a limited area, by being so thorough. The depth of coverage should also stand the reader in good stead when new techniques are being developed since the basics are handled so clearly in the text.

The graphics largely consist of line drawings and are sometimes not so easy to understand and would benefit from being clearer in some cases. More photographs of the types of laser-produced structures would also help to illustrate the ideas being presented. The references, however, are wide-ranging and carefully chosen and present a broad spectrum of research.

This book will be a useful tool for students and engineers wishing to gain a detailed insight into some aspects of laser microengineering. In my opinion, this book is not intended for those readers who want a quick "look up" guide of "How do I do XYZ?" but is for the more serious enquiry of the basics, the details and theory of laser processing.

This is a book which stands out from similar texts in its appreciation of the background and theory of laser processing. It presents a clear and detailed view of the areas it covers and should become a useful reference for many areas of laser-assisted MST.

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**Nadeem Rizvi** is a Senior Development Engineer at Exitech Limited. His particular interests include high-resolution micromachining systems using excimer lasers, new applications of laser microengineering techniques, the development of 193-nm photolithography microsteppers, and the use of laser line-narrowing techniques for lithography and grating writing.

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| **Title:** | ***Optics of Light Scattering Media: Problems and Solutions*** |
| **Author:** | Alex A. Kokhanovsky |
| **Publisher:** | John Wiley & Sons |
| **Year:** | 1998 |
| **Pages:** | 228 |
| **Price:** | $75.00 |
| **ISBN:** | 0-471-97260-6 |

The reviewed book deals with the scattering and absorption of light by small particles as well as with the radiative transfer process. These phenomena are fundamental to the study of disperse systems of various natures. That is why the results obtained are important in a very wide range of applications in optics of atmosphere and ocean, cell biology, colloidal chemistry, astrophysics, and astronomy. The well-thought-out structure of the text, happy choice of topics, precise definitions introduced preceding every consideration, and numerous useful tables make it possible to recommend the book for researchers in many fields.

The main emphasis of the text is to discuss the classical and modern analytical methods utilized in light scattering optics. The author derives equations, which relate the size, shape, and concentration of particles, their optical constants, and the energetic characteristics of electromagnetic fields. He developed the scattering theory based on the Maxwell equations, the approximate results of radiative transfer theory, and the complex problems of close-packed media. Analytic solutions for single and multiple scattering (including that by natural media), the regularization methods for ill-posed problems used in remote sensing, and their applications to atmospheric biological and planetary optics are of indisputable interest.

The great part of the book is devoted to results obtained by A. Kokhanovsky himself, for example, the scattering by layered spheres and spheroids within the framework of the anomalous diffraction approximation, optics of close-packed media, and applications in snow, foam, aerosols, and clouds.

Technical accuracy of the book is satisfactory. One can find detailed descriptions of exact and approximate solutions together with the numerical evaluations of the latter. Organization of the book is good and easy to follow. In Chapter 1 the author introduces the basic definitions and clearly states the main problems to study in the book. Chapter 2 is devoted to optical characteristics of single scatters that are studied as ones dependent on the values of size and refractive index of particles. The interesting investigations relative to nonspherical particles and the profound analysis of the edge effects carried out in items 3.3, 4.2.3–4.2.5, and 3.4 of this chapter should be noted. In turn, the approximate solutions of the transport theory problem in cases of small and large thickness, low and high absorption, and isotropic and highly anisotropic scattering are the subject of Chapter 3.

Such a wide range of input conditions is of importance when investigating scattering regimes together with radiation transfer within different media in a natural state. Chapter 4 deals with various problems of close-packed media, in particular, with their local optical characteristics and transmittance of light under different conditions. The formulas obtained are briefly discussed, and applied to a great number of problems in geophysics, radiative transfer, remote sensing, bio-optics and planetary optics in Chapter 5. The table of contents is very helpful in finding main results presented in the book.

There are a number of valuable books on light scattering and on radiative transfer, each taken separately. There are few advanced books in which both of the problems have been discussed together. The reviewed book occupies that peculiar position: it may be treated as a manual fit for studying many principal scattering and transfer problems without preliminary training. But it is necessary that the inaccuracies in the text and index be eliminated, and also, some questions (for example, T matrix theory) should be considered in detail.

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**Anri Ya. Perelman** graduated from the Mathematics Faculty of the St. Petersburg University in 1953. His research works with the principal questions of diffraction, scattering, and absorption of light by particles of the different nature, the ill-posed problems in optics. His main results have been published in *Applied Optics*, *Optics and Spectroscopy*, and other well-recognized journals. He obtained his Ph.D. in 1962 and his D.Sc. in 1994. He is currently Professor of the Mathematics Department at the St. Petersburg Forest Technical Academy, and is an internationally known expert in the optics of light scattering theory.

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