Book reviews

Engineering Optics

Keigo Iizuka

Springer Series in Optical Sciences, Vol. 35

Springer–Verlag Berlin, Heidelberg 1985
[pp. i–xv+489 with 385 Figures]

This book is an excellent monograph of modern optics. Keigo Iizuka shows the tempestuous development of applied optics up to the solution of optical engineering problems.

Engineering Optics contains 15 richly illustrated chapters and very well selected exercises and problems. It is intended not only for the physics and engineering students who want to acquire the basic principles of optics, but also for researchers and engineers who use optics in their research and/or profesional activity. For all these people, this book will be a valuable source of scientific information.

Chapter 1 contains the history of optics, while Chapters 2–7 include complete treatments of such important topics as: mathematical functions commonly used in optics, diffraction theory including, in particular, the Fresnel–Kirchhoff's diffraction formula and practical examples illustrating the Fourier-transform relationship, geometrical optics as the counterpart of Fourier optics including the geometrical optics of inhomogeneous media, Fourier transformable and image formable properties of lenses and, finally, the principle of the Fast Fourier Transform. Chapter 8 is devoted to coherent, computer and white light holographic techniques and their applications, Chapter 9 shown the laboratory procedures for fabricating holograms. The considerations concerning analysis of the optical system in the spatial frequency domain and the optical signal processing with linear filtering for both coherent and incoherent imaging (including a section on tomography), are given in Chapters 10 and 11. Chapter 12 extends the principles of holography to the microwave region since many holographic techniques are also applicable to acoustic holography. Finally, Chapter 13 describes the optical fiber communication systems, Chapter 14 introduces the reader to electro- and acousto-optics, and Chapter 15 covers the new but dynamically expanding field of integrated optics.

On page 65 the expression of the phase in Eq. (3.33) should be written in this form

$$\dots\left[k\frac{(x_i-x_0)^2+(y_i-y_0)^2}{2z_i}\right]\dots.$$

On page 163 the left side of Eq. (6.41) should be

$$\bar{P}\left(\frac{x_i}{\lambda d_2},\frac{y_i}{\lambda d_2}\right)=\dots,\ \text{instead of}\ \bar{P}(x,y)=\dots.$$

On page 365 the right side of Eq. (13.21) should be

$$=\frac{\partial n}{\partial T}dT+\frac{\partial n}{\partial\lambda}\frac{d\lambda}{dT}dT.$$

This beautiful book with marvellous illustrations presents so many interesting and important items that, in my opinion, it should became one of the basic references books in the library of any person being interested in optics.

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Scanning Electron Microscopy

Physics of Image Formation and Microanalysis

LUDWIG REIMER

Springer Series in Optical Sciences, Vol. 45

Springer–Verlag, Berlin, Heidelberg, New York, Tokyo
[pp. i–xv+460, with 247 Figures]

The present book, *Scanning Electron Microscopy* by LUDWIG REIMER, is a continuation of *Springer Series in Optical Science* publications and a counterpart of the earlier issue of *Transmission Electron Microscopy* (Vol. 36).

The book is an expansion of the lectures delivered by the author at the University in Münster. His intention was to write a book which would meet the requirements of specialists and skilled practicioners in SEM (Scanning Electron Microscopy), as well as those being introduced to the subject matter for the first time. As the microscopic images obtained by means of the SEM method differ considerably, mainly in terms of quality, from those obtained in the TEM method, the author attempted to explain these differences and to interprete them in an adequate way. His aim was to exclude the possibility of committing any mistakes which might appear in the course of analysing and interpreting the images formed in SEM. He fulfilled this task through the well-planned development of the contents and good arrangement of the chapters.

In the first two chapters he presents the bases for the formation of the SEM images, the structure of the main sub-assemblies of the microscopes and principles of their operation. Chapters two and three discuss various models of scattering and diffusion of electrons as well as manifold modes of their emission. In the succeeding chapters the author considers the detectors and signal processing and the procedures for obtaining the images with secondary and backscattered electrons. The remaining three chapters are intended for those who are, by profession, occupied with the SEM methods. They deal with special techniques, crystal structure analysis by diffraction methods, and X–ray analysis of the images.

In my opinion, the author's primary aim has been fully accomplished, and his book can be recommended as a valuable reference guide to everyone who takes interest in the electron microscopy.

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Nonlinear Optics: Materials and Devices

Proceedings of the International School
of Materials Science and Technology, Erice, Sicily,
July 1–14, 1985

Editors: C. FLYTZANIS and J. L. OUDAR

Springer Proceedings in Physics, Vol. 7

Springer–Verlag, Berlin, Heidelberg, New York, Tokyo
[pp. i–viii + 252, with 185 Figures]

The book *Nonlinear Optics: Materials and Devices*, edited by C. FLYTZANIS and J. L. OUDAR, contains lectures read at the International School of Materials Science and Technology at Erice, Sicily, on July 1–14, 1985. The aim of the lectures, and thus the purpose of the book, is to give a description and to promote the understanding of the nonlinear interactions of optical beams and short light pulses in reduced space geometries and shapes appropriate to small-size all-optical devices and the response of the nonlinear material in such reduced time and space extensions.

The book consists of four parts, the third containing four chapters and each of the others – three.

The first part: *Nonlinear optics in guides structures* deals with the very intricate problem of nonlinear optical interactions in different restricted geometries. In first lecture, H. A. HAUS discusses the theory of single-mode waveguide couplers and interferometers which transform phase modulation into amplitude modulation. Second lecture, by G. I. STEGEMAN et al., is devoted to the effects due to nonlinear interaction of two or three light waves in a waveguide (second-harmonic generation, sum and difference frequency generation, parametric amplification and oscillation, degenerate four-wave mixing, coherent anti-Stokes Raman scattering, intensity-dependent refractive index). The lecture on *Nonlinear interactions and excitonic effects in semiconductor quantum wells*, by D. S. CHEMLA, contains a review as well as the theory of the nonlinear optical processes and electro-absorption effects occuring in semiconductor quantum well structures in the presence of cw, pico- and femto-second excitations.

Part II *Ultrafast charge carrier dynamics in semiconductors* comprises three lectures: *Femtosecond lasers and ultrafast process in semiconductors*, by C. L. TANG, *Transient nonlinear optical effects in semiconductors*, by J. L. OUDAR, and *Picosecond luminescence studies of electron-hole dynamics in semiconductors*, by E. O. GÖBEL. Here, the discussion bears on ultrafast dynamical processes apparent in optically exited semiconductors, with stress laid on the production of pico- and femto-second pulses and their applications in studies of fast process in semiconductors and in related multiple quantum well structures (relaxation dynamics of hot carriers, saturation of band-to-band transition in a direct gap semiconductor and electron-hole dynamics).

In Part III *Nonlinear optical materials*, we find an up-to-date presentation of modern trends in the field of new materials for use in nonlinear optics. G. R. MEREDITH, in his lecture on *Prospect of new nonlinear organic materials*, discusses the nonlinear properties of organic molecules and crystals, characterized by high values of their second- and third-order nonlinear polarizabilities and thus promising to become useful components of future experimental and practical devices. Lecture II, by I. P. HUIGNARD and G. ROOSEN deals with the problem of the practical exploitation of materials exhibiting photoinduced changes in refractive index – in general, electro-optical crystals. Here, we have a discussion of the mechanism of the photorefractive effect as well as its various applications, in particular to image amplification, dynamic holographic interferometry, phase conjugation and photorefractive oscillations. The next lecture *Optical fibres with organic crystalline cores*, by B. K. NAYAR, concerns the propagation of light and the mixing of three light waves in such fibres. In his lecture on

Nonlinear optics and surfaces and in composite materials, D. RICARD deals with the surface enhanced Raman scattering and second-harmonic generation by surface and molecular monolayers and its applications. Moreover, the lecture gives a discussion of optical phase conjugation in composite media such as metal colloids and semiconductor-doped glasses.

Part IV *Optical bistability and instabilities in nonlinear optical devices* consists of three lectures, the first of which is by B. S. WHERRETT, who discusses the fundamental properties of semiconductor optical bistable elements. Moreover, the experimental observations of bistable switching of cw laser beam in both the infrared and visible spectral regions and device applications are reported, including some speculations for optical computer architectures. The second lecture *Optical bistability and nonlinearities of the dielectric function due to biexcitons*, by I. B. GRUN, gives a discussion of the non-linear dielectric function due to biexcitonic optical transitions, which is applied in the production of an optical bistable elements in copper chlorides. In the last lecture on *Instabilities and chaos in nonlinear optical beam interactions* C. FLYTZANIS considers instabilities and transition to chaos in a passive nonlinear Fabry–Pérot cavity and nonlinear optical systems.

The book is highly interesting. The subject matter covers the newest achievements in nonlinear optics. The treatment is clear throughout. The book is also destined for engineers and physicists working in the field of quantum electronics, nonlinear optics, materials science, optical communications, information processing, and optical computering. The reader is presumed to be familiar with the fundamentals of nonlinear optics, solid state physics, as well as quantum mechanics.

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