phenomena these systems display may still be far too simple to explain, even qualitatively, more than a small fraction of the chaotic phenomena we encounter every day.

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Advanced Light Microscopy, Vol. 3: Measuring Techniques

Maksymilian Pluta
Elsevier, New York, 1993.
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As Lord Kelvin often said, if you measure that of which you speak, you know something of your subject, but if you cannot measure it, your knowledge is meager and unsatisfactory. Microscopy is more than just looking at small objects; if it is to be used effectively, it must also be used as a measuring tool. In general, all microscopical observations involve an approximate size estimation. With small particles, although morphological features are invaluable, measured physical, chemical and optical properties are often necessary to confirm an identification. Maksymilian Pluta, a physicist and microscopist at the Institute of Applied Optics, Warsaw, Poland, has drawn on his study of physical optics and his interest in the interference and polarization of light to describe the use of the microscope as a measurement tool for the biomedical and materials sciences.

The two previous volumes in his trilogy *Advanced Light Microscopy* [*Volume 1: Principles and Basic Properties* (1988); *Volume 2: Specialized Methods* (1989); Elsevier] dealt with physical and geometric optics, image formation, optical performance of the light microscope and all the various techniques for enhancing microscopical image contrast. Both were critically acclaimed as modern classics. I was not surprised to find that Volume 3, on measurement, is likewise a valuable resource, complete in itself and remarkably up-to-date in its references to relevant applications. Pluta addresses virtually every possible issue with regard to measurement using the light microscope.

This final volume in the trilogy includes rigorous explanations of linear and stereological micrometry using mechanical and optical devices, microspectroscopy, flow cytometry, polarized light microscopy using rectified optics and video-enhanced contrast, and optical microdiffraction. The techniques are thoroughly described; although, to our loss, he occasionally leaves us without a reason for thinking about their usefulness.

One highlight is the exhaustive treatment of birefringence measurement, illustrated particularly well by man-made fibers. Another is an interesting description of a laser Doppler microscope that combines the spatial resolving power of a light microscope with the velocity measurement of the Doppler effect. And Pluta thoroughly covers new microinterferometric techniques that enable refractive indices, birefringence and thickness to be measured more accurately. When applied to metals, interferometry offers useful information about such properties as distortion under load, elastic recovery and abrasive hardness. Interferometry appropriately applied could probably reveal more details about more types of materials than the new scanning probe microscopes with which people are experimenting.

Most scientists teach themselves how to measure with the microscope; Volume 3 of *Advanced Light Microscopy* should be valuable to the student whose thesis requires careful measurement or the engineer who needs a measuring procedure to meet international quality standards. As manufactured devices decrease in size and microscopic dust, impurities and inclusions become more intolerable, my experience as a consulting microscopist has shown that many of the failures in these devices can be detected and identified only by means of the microscope. Rapidly advancing manufacturing and biomedical technologies make the timing of this book perfect. It is a source for nearly all one needs to know about the measuring techniques of light microscopy.

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Erbium-Doped Fiber Amplifiers: Principles and Applications

Emmanuel Desurvire
Wiley, New York, 1994.
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It is now widely recognized that erbium-doped fiber amplifiers have revolutionized optical fiber communications. EDFAs not only made single-channel, multigigabit-rate, long-distance optical communications possible, but they also opened up a wide variety of additional possibilities such as soliton generation and transmission and multichannel wavelength-division multiplexing communications. While at AT&T Bell Labs (he is now at Alcatel–Alsthom Recherche in a suburb of Paris, France) Emmanuel Desurvire became heavily involved in and contributed enormously to the theoretical and experimental investigation of EDFA characteristics and system applications. His pioneering work has been internationally recognized. In my view, Desurvire is one of those best qualified to cover the subject of EDFAs; in *Erbium-Doped Fiber Amplifiers: Principles and Applications*, he has accepted the challenge.

According to the author, the purpose of the book is "to provide the basic materials of a comprehensive introduction to the principles and applications of EDFAs." The book is divided into three major parts, which to some extent can be considered independently. Nonetheless, it keeps its cohesion throughout. It provides a thorough understanding of the fundamentals in optical amplification while considering the practical issues related to the device and system performance of EDFAs.

The first part of the book explores all the fundamental issues related to EDFAs. It introduces the main concepts necessary for the modeling of the erbium atomic transition. The analysis is detailed and covers such parameters as field distributions and overlap integrals under different operating conditions. This section and the numerous relevant appendices contain a number of useful generalizations of existing models that are published for the first time.

The author also considers the fundamental quantum properties of noise generation and accumulation in single- and multiple-stage amplification of classical light. The analysis discusses in great depth the nature, origin and inevitability of noise associated with optical amplification; it also provides useful engineering formulas for the measurement of the noise introduced by amplification. I found the treatment of noise and photon statistics particularly detailed and original. Researchers working on this subject can benefit enormously from the analysis.

The second part is primarily experimental and focuses on EDFA device characteristics. However, when specific characteristics of the erbium transition are discussed, the necessary theoretical modifications and additions, supplementary to the general formulations given in the first part,

are provided. I found that on the important issue of pulse amplification requirements, the book considers briefly only the special (but very exciting) case of solitons and misses the many problems associated with general pulse amplification.

The third and final section of the book, on applications, is primarily concerned with some of the up-to-date linear and nonlinear communication systems and local area networks and the enormous impact that EDFAs have had on their successful implementation. The significance of the EDFAs in optically preamplified receivers is stressed. The most significant digital (linear) and soliton (nonlinear) system experiments performed to date are also reviewed. Limitations imposed on linear systems by fiber nonlinearities and dispersion are briefly mentioned. The ground that Desurvire sought to cover in the third part is quite diverse and could well have been the subject of several separate volumes. Therefore, its inclusion in this book is inevitably of a review type. However, the book clearly points out how and to what degree these applications are benefited or enhanced by EDFAs.

Overall the book gives one of the most comprehensive and detailed accounts of the physics and fundamental principles of erbium-doped fiber amplifiers published so far. I have not the slightest doubt that the book will be of great help to all scientists and engineers working in the field who are struggling to understand EDFAs. The unified and in-depth presentation of the subject will benefit in particular researchers and graduate students who are dealing with problems involving optical amplification. The book imparts the fundamental concepts quite skillfully and can be used as collateral reading. The sections dealing with modeling and the entire second part could well be used in undergraduate courses. I do not hesitate to recommend the book enthusiastically to anybody having an interest in EDFAs and their applications.

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The Surface Science of Metal Oxides

V. E. Henrich and P. A. Cox
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ISBN 0-521-44389-X

Metal oxide surfaces are as interesting as they are complex. The surface properties of metal oxides play a