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BOOK REVIEW

Fundamentals of Fluorescence Microscopy: Exploring Life with Light

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Fundamentals of Fluorescence Microscopy: Exploring Life with Light by Partha Pratim Mondal and Alberto Diaspro, Springer, Dordrecht, 2014, pp. xvi + 218. Scope: textbook, $69.99 (or eBook $54.99), ISBN 978-94-007-7544-2 (Hardcover) or 978-94-007-7545-9 (eBook). Level: professional physicists and biologists, postgraduates, undergraduates.

Many (some would say most) of the major advances in biology and medicine have occurred through the application of new ideas from physics. The introduction of optical microscopy in the 17th century, followed by fluorescence microscopy some 300 years later, are two such examples each of which markedly accelerated progress. In conventional optical microscopy the instrument simply produces a magnified image of the sample, always at the same wavelength as the illumination, which normally takes the form of white light used in transmission. Contrast within a biological structure tends to be poor, so it is normally improved by means of dyes that are taken up preferentially by different structures. The techniques needed for sample preparation usually preclude *in vivo* examination imaging.

Fluorescence microscopy, on the other hand, relies on molecules in the sample fluorescing (or phosphorescing) to emit at a different wavelength from that of the illumination. These marker molecules may be e.g. from a dye, or may be part of the sample itself e.g. internal parts of a cell modified by standard molecular biology methods. With use of appropriate optical filters, only the fluorescing regions are seen, giving a huge improvement in contrast. Furthermore, the classical diffraction limit no longer applies in the same way and it is possible to discern structures down to dimensions of a few nm. Finally, perhaps the most important feature of all, is that the functioning of a living cell can be imaged in real time using fluorescent tracers attached to the cellular components of interest or even to individual molecules whose movements can then be traced.

There is now an enormous range of different fluorescence imaging techniques, resulting in the emergence of whole new fields like nanobioimaging, nanomedicine and lab-on-a-chip design. The technology is inherently interdisciplinary, requiring knowledge of classical optics, quantum optics, and molecular physics. Mondal and Diaspro have produced an introductory text providing all the necessary scientific background for students in applied physics, biophysics and biomedical engineering, Their text is also intended to be used by scientists and engineers in both industry and academia.

The work is in two parts. The five chapters of Part I cover the basics and background in classical ray optics, waves, electricity and magnetism, quantum theory, and molecular physics – most of it at the level of 1st year undergraduate physics. This prepares the way for Part II, which consists of six chapters on advanced imaging covering e.g. theory of fluorescence, bleaching and its reduction, multiophoton and super-resolution fluorescence microscopy, image reconstruction methods, and future perspectives. All chapters except the last one end with recommended reading (mostly

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books) and all have a list of references. There are three appendices with additional mathematics and relevant data. There is no index.

The book is generally well written for the intended readership, though it would have been even better if a native English speaker had given it a final read through. It is nicely produced with large (almost A4 sized) glossy pages and some very attractive and interesting coloured images.

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