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Book Review

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Enzyme catalysis in organic synthesis,

Wiley–VCH, 2002, 2nd edition, 1559 pp.
price £415.
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This three-volume set, appearing 8 years after the first edition of *Enzyme Catalysis in Organic Synthesis*, provides an update on a field that has matured considerably over the intra-edition period to become well established in both academia and industry. Despite a maturing of the field, rapid developments in molecular biology are beginning to change the landscape and hold promise for taking the field to new levels of advancement. The basic organization of the material is much the same as the first edition, with a part (Volume I) covering general principles preceding one that summarizes the application of enzymes in organic synthesis according to reaction type (Volumes II and III).

Volume I (the lightweight of the three, with 334 pages) covers much of the established technology that forms the backbone of the field, with chapters on: the production and isolation of enzymes; immobilization of enzymes; reaction engineering for enzyme-catalysed biotransformations; enzymatic kinetic resolution; and enzymes from extremophilic bacteria. Much of the remainder of this volume deals with molecular-biology-based technologies that have most profoundly influenced the field since the first edition, or are likely to in the near future. The relevant chapters are rational design of functional proteins, enzyme engineering by directed evolution, and enzyme bioinformatics. There is also a welcomed chapter on enzymatic conversions in organic and other low-water media, reflecting the increasing importance of these aspects to the field. All chapters are based primarily on the secondary literature (review articles and book chapters). Greater emphasis could have been placed on a systems biology approach to biocatalysts; an additional chapter bringing together genomics, proteomics and other '-omics' would not have been amiss. Also, given the fundamental importance that 'protein stability' has to the field, inclusion of a chapter dealing with the associated general principles would have been appropriate.

Volume II (the heavyweight of the three, with over 600 pages) has the character of a reference text and is organized into only four chapters, devoted to C–O, C–N, P–O and C–C bonds. A massive 363 pages is devoted to hydrolysis and formation of C–O bonds, reflecting the importance of hydrolases as chiral catalysts for organic synthesis on both the laboratory and industrial scales. This is a multi-authored chapter, with contributions organized into sections dealing with: carboxylid acid esters; epoxides; glycosidic bonds; natural polysaccharide-degrading enzymes; and addition of water to C–C bonds. The chapter on hydrolysis and formation of C–N bonds has major sections on nitriles, amides, *N*-acylamino acids, hydantoins, peptides, addition of amines to C═C bonds, and transaminations. Formation and hydrolysis of carbon–metal bonds are not considered in these volumes.

Volume III (the middleweight of the three, with 527 pages—excluding the index) is organized into five chapters covering reduction reactions, oxidation reactions, isomerizations, introduction/removal of protecting groups, and replacing chemical steps by biotransformations. The chapter on reduction reactions has major sections on ketones, various functionalities, and C═N bonds; that on oxidation reactions has sections dealing with C–H and C═C bonds, alcohols, phenols, aldehydes, Baeyer–Villinger oxidations, acids, C–N bonds, sulfur, and halogenation. Finally, in this volume, there is a tabular survey of commercially available enzymes. Here, the author admits that the list is incomplete and probably needs updating before the book is even in print. Nevertheless, the survey represents a useful initial resource and is an appropriate inclusion for a text of this character. The index to all three volumes is also provided in Volume III. While recognizing the difficulties of compiling a comprehensive index for such a large resource of factually rich material, this index still disappoints. One can not help feeling that this 'handbook' would be better served by the CD-ROM medium, rendering the material far more accessible to the reader.

Volumes II and III consider all the main issues relevant to the reactions under consideration, and much more besides. Chapter coverage may include, as appropriate: reaction mechanisms; classification of enzymes; sources of organisms and enzymes production of the biocatalysts; substrate specificity; enzyme stability; improvements through molecular biology; inhibitors; organic solvents; cofactor regeneration; and applications. All chapters are supported by ample reference to the primary literature.

There are several related titles on the market, with *Biocatalysis: Fundamentals and Applications* (A. S. Bommarius and B. R. Riebel; Wiley–VCH, 2004) as the most recent. Whereas that text provides wider coverage of the general principles of biocatalysis, its treatment of enzymes in organic synthesis is distinctly lightweight by comparison with the tomes under review here. The editors of the present text have brought together an unrivalled wealth of knowledge and experience from 51 contributors and ultimately, despite some limitations on general principles, the text is destined to become known as 'The Handbook' for biological catalysis in organic chemistry—at least until the third edition appears.

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