

Organic Synthesis Using Biocatalysis

The field of biocatalysis, in which enzymes and whole cells are employed for preparative organic synthesis, is currently undergoing its greatest rate of change since enzymes were first used for synthetic transformations at the beginning of the 20th century. During the past 10 years the combination of advances in a number of key technology areas have enabled researchers to both discover many more novel enzyme sequences and activities and also importantly engineer these enzymes so that they possess the levels of activity and selectivity that make them suitable for applications in organic synthesis. As a community we have learnt how to discover new enzymes by a combination of metagenomics, sequence based algorithms for interrogating data-bases and functional screening for desired chemical transformations. Candidate enzyme sequences that emerge from this approach can then be subjected to rounds of directed evolution or structure-guided protein engineering in order to fine tune their properties. Finally we have the option of formulating these enzymes via immobilization in order to generate stable biocatalysts that can be used on a manufacturing scale in industry. Underpinning these scientific developments are major advances in genome sequencing and DNA synthesis which when aligned with our ability to discover and engineer biocatalysts suggest that we are now entering a golden age of biocatalysis. As more biocatalysts become available there is a palpable shift of emphasis towards application, particularly in organic synthesis, hence the timely nature and appropriate title of this book *Organic Synthesis Using Biocatalysis* edited by Animesh Goswami and Jon Stewart.

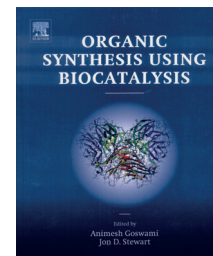
Goswami and Stewart have assembled a team of internationally renowned authors, drawn from both academic departments and industrial laboratories, who together via a series of 12 themed chapters take the reader through key topics regarding the application of biocatalysis in organic synthesis. Chapters 1–4 cover introductory material such as sources of biocatalysts, types of transformations that can be achieved, practical aspects

including engineering, use of neoteric solvents and enzyme immobilization. Chapters 5–10 then deal sequentially with some of the major types of biocatalysts that currently find widest application including hydrolytic enzymes, reduction, amine synthesis, hydroxylation, carbon-carbon bond forming enzymes and also a chapter on other important enzymes such as ene reductases and Baeyer–Villiger monooxygenases. These chapters helpfully contain examples of experimental protocols which will undoubtedly promote the uptake of biocatalysis in preparative synthesis. Chapter 11 focuses on applications of biocatalysts in the synthesis of pharmaceuticals and emphasizes the way in which biocatalysis has really begun to make inroads into this part of the chemical industry. Finally Chapter 12 concludes with some future perspectives and suggestions for areas of further development.

This is an excellent book aimed at postgraduate scientists in universities and industry who wish to gain a real appreciation of where and how biocatalysis is impacting upon organic synthesis. The book contains information on enzyme mechanism and structure together with a plethora of examples regarding synthetic application. All of the chapters contain a full reference list which again is helpful. I regard this book as a reflection of a transition in thinking from “what reactions can enzymes usefully catalyze?” to “how can I synthesize a particular target molecule using a biocatalyst?” Synthetic organic chemists are trained to think in terms of “retrosynthesis” which equates to generating potential building blocks from an analysis of the target molecule via various putative disconnections. These disconnections are only possible if the forward reaction is known. By analogy the development and implementation of “biocatalytic retrosynthesis” will need to be coupled to a much better understanding and awareness of what enzyme-catalyzed transformations are possible and in this particular respect the book makes a major and important contribution.

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