



A D V A N C E S I N
Biocatalytic Technologies

2 N D E d i t i o n



The Report

Biocatalysts have long been used in pharmaceuticals, detergents, and food products. However, recent advances in genetic engineering, improved stabilization and immobilization techniques, as well as a better understanding of structure-function relationships, is attracting the attention of chemists and engineers for applications outside these traditional businesses. Biocatalysts, including isolated enzymes, microorganisms, plants, and catalytic antibodies, offer the following benefits:

- Environment-friendly materials and reaction conditions
- Stereoselectivity and regioselectivity
- New reactions beyond traditional chemical synthesis

Development of new biocatalysts and improvements in process design and engineering are fueling heightened interest in biocatalysis to solve critical industrial problems and to create alternate synthetic routes. As these technological advances evolve, emerging markets for biocatalysts, e.g., fine chemicals, pharmaceuticals, consumer products, and industrial chemicals, will provide significant growth.

Technology Catalysts International's Chiral and Fine Chemicals research and business strategy staff has completed an extensive analysis of next-generation biocatalytic processes and technologies in order to identify potential business opportunities in biocatalysis. Unpublished information has been gathered via personal interviews on the research and development activities at universities, large and small companies, and product development firms in North America, Europe, and Asia.

Advances in Biocatalytic Technologies outlines "state-of-the-art" biocatalytic technologies, identifies next-generation products and process technologies, and examines niche opportunities from a technological viewpoint. The report provides critical information and analysis of biocatalytic technologies including:

- Innovations in enzyme technologies such as enzyme engineering, stabilization, and immobilization techniques
- Applications of enzymes in industrial chemical production
- Biocatalytic production of pharmaceuticals, agrochemicals, and fine chemical intermediates
- Non-enzymatic biocatalysts, for example catalytic antibodies and peptides

In addition to the analysis of technological innovations in each of these areas, the report provides detailed information on research and development activities of about 100 large and small companies, universities, and research centers worldwide. This report identifies:

- New product or market opportunities
- Partners for joint ventures or co-development opportunities
- Suppliers of new ingredients or products

The Company

Technology Catalysts International, founded in 1979, provides consulting services that satisfy the technology transfer and business research needs of industry. Today we specialize in technology transfer, technology assessment, and intellectual property portfolio management. The firm's head office is located in Falls Church, Virginia, a suburb of Washington D.C. Our global network includes offices in Japan, Korea, India, China, Argentina, Canada, United Kingdom, Germany, and the Czech Republic.

Our Research staff is comprised of professionals with backgrounds in a variety of technical disciplines, international marketing, licensing, finance, and business development. They are skilled in providing clients with strategically important competitive information worldwide. The breadth of our experience assures clients of high quality, actionable information and complete coverage of topics of interest.

TCI's core consulting services are based on continuous monitoring of technological and product development activities on a global basis. The company provides consulting and technology transfer services to leading product developers and manufacturers in North and South America, Europe, and Asia. Our client base consists of small, medium, and large corporations.

For more information on our services and capabilities, please contact your local representative or visit our website at www.technology-catalysts.com.

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Emerging Markets

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Introduction

Enzymes as a Tool for Functional Genomics and Proteomics

- Merrimack Pharmaceuticals
- Yale University

Pathway Analysis and Engineering

- Rensselaer Polytechnic Institute

Enzyme Engineering

- Academy of Sciences of the Czech Republic
- Actinodrug Pharmaceuticals GmbH
- Albany Molecular Research, Inc.
- Buckman Laboratories International, Inc.
- California Institute of Technology
- Consejo Superior de Investigaciones Cientificas
- K. U. Leuven Research and Development
- LG Chemical Ltd.
- Maxygen, Inc.
- Michigan State University
- National Science Council
- Nippon Shokubai Co., Ltd.
- Novo Nordisk A/S
- Novozymes A/S
- Quidel Corporation
- Roche Vitamins, Inc.
- ThermoGen, Inc.
- University of Glasgow
- University of Stuttgart
- U.S. Army Medical Research and Material Command
- Xencor
- Xtremogen

Selective Biotransformations

- BASF AG
- Dow Chemical Company
- Egea Biosciences, Inc.
- Max-Planck-Institut für Kohlenforschung
- Polytechnic University
- The Scripps Research Institute
- University of California

V. Industrial Applications of Enzymes

Introduction

Company Summaries

- Beijing Patent Agency
- Biocatalysts Ltd.
- Broin and Associates, Inc.
- Buckman Laboratories International, Inc.
- Centre National de la Recherche Scientifique
- Consejo Superior de Investigaciones Cientificas
- Deva Processing Services Ltd.
- Diversa Corporation
- Enchira Biotechnology Corporation
- Genencor International, Inc.
- General Electric Company
- Maxygen, Inc.
- National Renewable Energy Laboratory
- Novozymes North America, Inc.
- Rhodia-Ster S.A.
- Royal Agricultural University
- The NutraSweet Company
- UFZ Umweltforschungszentrum Leipzig-Halle GmbH
- Unilever Home & Personal Care USA
- University of Wisconsin

VI. Fine Chemicals

Introduction

Pharmaceutical Compounds—

Company Summaries

- Albany Molecular Research, Inc.
- Altus Biologics Inc.
- CSIR Bio / Chemtek
- Kyowa Hakko Kogyo Co. Ltd.
- Roche Diagnostics GmbH
- Sarawak MediChem Pharmaceuticals, Inc.
- Syngenta Participations AG
- The Scripps Research Institute
- Ultrafine Chemicals Ltd.

Fine Chemical Intermediates—

Company Summaries

- Adisseo
- Altus Biologics Inc.
- Aventis CropScience GmbH
- BASF AG
- BioResearch Ireland
- Bristol-Myers Squibb Company
- Daicel Chemical Industries, Inc.
- Daiso Co. Ltd.
- Degussa Fine Chemicals
- Diversa Corporation
- Dow Chemical Company
- Eidgenössische Technische Hochschule Zürich
- E. I. du Pont de Nemours and Company
- Evologic S.A.
- Great Lakes Chemical Corporation
- Hoechst AG (Aventis Pharmaceuticals, Inc.)
- Isis Pharmaceuticals, Inc.
- Jülich Fine Chemicals GmbH
- Kaneka Corporation
- Korea Research Institute of Bioscience and Biotechnology
- Kyowa Hakko Kogyo Co. Ltd.
- Mercian Corporation
- Morphochem AG

- Nippon Soda Co., Ltd.
- Novartis AG
- Pfizer Inc.
- Pharmacia Corporation
- Roche Diagnostics GmbH
- Schering-Plough Corporation
- SK Energy and Chemical
- Synthetech, Inc.
- The Scripps Research Institute
- University of Florida
- University of Groningen
- University of Iowa
- University of Michigan
- Wacker Fine Chemicals
- Zambon Group S.p.A.

VII. Non-Enzymatic Biocatalysts

Development of New Non-Enzymatic Biocatalysts

Company Summaries

- Abiogen Pharma S.p.A
- Amrad Operations Pty. Ltd.
- BASF AG
- Boston Biomedical Research Institute
- Columbia University
- Curis, Inc.
- IGEN International, Inc.
- INSERM
- Magainin Pharmaceuticals Inc.
- Quest International B.V.
- Tel Aviv University
- The Scripps Research Institute
- University of Nebraska

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