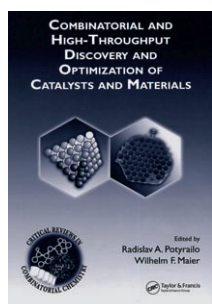




Combinatorial and High-Throughput Discovery and Optimization of Catalysts and Materials



Edited by Radislav A. Potyrailo and Wilhelm F. Maier.
CRC Press/Taylor & Francis Group,
Boca Raton 2006.
473 pp., hardcover
€ 199.95.—ISBN
0-8493-3669-4

Combinatorial chemistry and the use of high-throughput screening methods have become very important in the areas of catalyst research and the development of new materials, and rapid advances are continuing. A few monographs on the subject, dealing with specific aspects of the techniques and methods, have already appeared. These include the *Handbook of Combinatorial Chemistry, Vol. 2: Drugs, Catalysts, Materials*, by K. C. Nicolaou, R. Hanco, and W. Hartwig, and *High-Throughput Screening in Chemical Analysis*, by A. Hagemeyer, P. Strasser, and A. F. Volpe, Jr. In the book reviewed here, R. A. Potyrailo and W. F. Maier have collected together 23 highly topical review articles by international authors from academic and industrial research laboratories, and grouped them under six topic areas.

The first section is devoted to the state-of-the-art combinatorial method of high-throughput screening, and especially to using the methods of information technology for the interpretation and evaluation of the large quantities of data that are generated. Descriptor

models for the interpretation of material properties are explained with the help of examples. In particular, these articles consider the following questions: What types of problems can be solved with the techniques that are now available, and what limitations still remain to be overcome? Where have combinatorial methods and high-throughput techniques been successfully applied up to now? What are the advantages of high-throughput techniques in giving better reproducibility of conditions for synthesis and study compared with conventional methods? These questions are discussed with the help of practical examples from the areas of catalyst development or the optimization of materials for gas-sensitive field-effect devices.

The second section focuses on the discovery, preparation, and testing of catalysts for homogeneous and heterogeneous catalysis. The articles show that the use of combinatorial methods and high-throughput techniques is not limited to chemical composition and analysis, but can include the systematic study and optimization of reaction conditions, such as heat treatment of catalysts. In connection with the use of infrared thermography for determining catalytic activities, the articles also discuss developments in instruments, which are leading to rapid advances in high-throughput screening. High-throughput screening of catalysts is described and discussed step by step, with many practical experimental examples, such as the carbonylation of phenol.

The third section is concerned with the development of functional polymers, from the viewpoints of materials characterization and structure-properties correlation. Here too there are detailed descriptions of experiments, protocols, and analytical techniques, with informative practical examples from the areas of polymer synthesis, surface coatings, photochromic dyes, and electrically conducting polymers.

The fourth section deals with a highly topical area of research, the high-throughput screening of materials for the storage and conversion of energy in batteries and fuel cells. Special attention is devoted to the synthesis of electrode materials, and the accompanying work on their electrochemical

characterization, screening by optical and electrochemical microscopy methods, and infrared thermography.

The fifth section is concerned with the development of electronics materials, especially for data storage in hard disks and for use as computer information storage media (RAM). The articles describe techniques for depositing several layers on a substrate with a gradient of layer thicknesses, and thereby investigating the coercivity as a function of position. These examples of applications provide an impressive demonstration of how effectively the methods can be used for the discovery and optimization of new materials. Another topic covered is the combinatorial synthesis of semiconductor nanoclusters using ion beams, their deposition in a positionally controlled way on disk substrates, and the characterization of the clusters thus obtained. The section ends with an article on the creation of libraries of thin films by the sol-gel process.

Lastly, the sixth section describes the application of combinatorial methods and screening techniques to optical materials such as organic LEDs or luminescent materials. This section in particular is strongly applications-oriented, and covers topics such as the investigation of phosphorescent materials for the manufacture of plasma television screens. Some new techniques are also discussed, such as the use of genetic algorithms in combinatorial syntheses.

The book presents a richly varied collection of articles on combinatorial methods and high-throughput screening techniques for fundamental research, and examples of practical applications in research on catalysts and materials. Therefore, it not only provides an excellent overview of the subject as a reference source, but also makes interesting and stimulating reading.

Oliver Trapp

Max-Planck-Institut für Kohlenforschung
Mülheim/Ruhr (Germany)

DOI: 10.1002/anie.200685464