CATALYSIS – Science and Technology

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CATALYSIS

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Editorial

Our series of books on *Catalysis: Science and Technology* is by now nearly complete. Its purpose has been to collect authoritative and, if possible, definitive chapters on the main areas of contemporary pure and applied catalysis. Its style is not that of an Advances series, nor is it meant to be a collection of up-to-date reviews. If the chapters and the volumes were following each other in a neat, logical order, our series might be considered as trying to emulate the original *Handbuch der Katalyse*, pioneered by Professor G.M. Schwab in the 1940's, or be a new version of *Catalysis*, the series edited by Professor P.H. Emmett in the 1950's. As a matter of expediency, to avoid the delays involved in assembling a complete volume of related chapters, we decided at the outset to publish the chapters as received from our authors.

We submit that, by the time our series is complete, our main objectives will have been met. We are most thankful to all our contributors for their co-operation. The Science and the Technology of Catalysis will prosper as a result of their hard work.

General Preface to Series

In one form or another catalytic science reaches across almost the entire field of reaction chemistry, while catalytic technology is a cornerstone of much of modern chemical industry. The field of catalysis is now so wide and detailed, and its ramifications are so numerous, that the production of a thorough treatment of the entire subject is well beyond the capability of any single author. Nevertheless, the need is obvious for a comprehensive reference work on catalysis which is thoroughly up-to-date, and which covers the subject in depth at both a scientific and at a technological level. In these circumstances, a multi-author approach, despite its well-known drawbacks, seems to be the only one available.

In general terms, the scope of *Catalysis: Science and Technology* is limited to topics which are, to some extent at least, relevant to industrial processes. The whole of heterogeneous catalysis falls within its scope, but only biocatalytic processes which have significance outside of biology are included. Ancillary subjects such as surface science, materials properties, and other fields of catalysis are given adequate treatment, but not to the extent of obscuring the central theme.

Catalysis: Science and Technology thus has a rather different emphasis from normal review publications in the field of catalysis: here we concentrate more on important established material, although at the same time providing a systematic presentation of relevant data. The opportunity is also taken, where possible, to relate specific details of a particular topic in catalysis to established principles in chemistry, physics, and engineering, and to place some of the more important features into a historical perspective.

Because the field of catalysis is one where current activity is enormous and because various topics in catalysis reach a degree of maturity at different points in time, it is not

expedient to impose a preconceived ordered structure upon *Catalysis: Science and Technology* with each volume devoted to a particular subject area. Instead, each topic is dealt with when it is most appropriate to do so. It will be sufficient if the entire subject has been properly covered by the time the last volume in the series appears. Nevertheless, the Editors will try to organize the subject matter so as to minimize unnecessary duplication between chapters, and to impose a reasonable uniformity of style and approach. Ultimately, these aspects of the presentation of this work must remain the responsibility of the Editors, rather than of individual authors.

The Editors would like to take this opportunity to give their sincere thanks to all the authors whose labors make this reference work possible. However, we all stand in debt to the numerous scientists and engineers whose efforts have built the discipline of catalysis into what it is today: we can do no more than dedicate these volumes to them.

Preface

NMR methods have for a considerable time been standard processes for the analysis of molecular structure: so much so that they are now universally regarded as indispensable for this purpose. Nevertheless, with the passage of time, NMR methodology has been elaborated to levels of ever increasing complexity and analytical sophistication so that the non-specialist may now be readily excused for the belief that for anything beyond relatively elementary methods one would be well advised to work in collaboration with the specialist experts.

The application of NMR methods to the field of catalysis occurred, in the main, relatively late in the day, mainly because those catalysts of greatest industrial importance, that is heterogeneous catalysts, are solids and so require special NMR methods if usefully narrow NMR lines are to be observable. Even so, magic-angle spinning NMR methodology is now thoroughly well established and is finding increasing use in the study of catalyst structure. Of course, conventional NMR methods have been used for a considerable time for the analysis of the products of catalytic reactions.

Chapter 1 of the present volume by Professor Jacques Fraissard and his collaborators is designed to give an account of the application of NMR methods to the field of catalysis, but not including the conventional use of NMR for reaction product analysis, since this is already well covered in the existing NMR literature.

The fact is that those who wish to use NMR methods will receive the greatest reward if they approach the subject with a reasonable grounding in the theory, and for this reason Chapter 1 gives an introduction to the more important aspects of NMR theory, in the light of which the later parts of the Chapter are to be viewed. Following this theoretical

introduction, Chapter 1 proceeds to a discussion of various specific applications, including the study of adsorbed molecules, the structure of important classes of catalysts by NMR methods using nuclei such as ^{29}Si, ^{27}Al and ^{51}V, the use of NMR methods for studying the acidity of solids, the NMR of physisorbed ^{129}Xe for the study of catalyst structure, the use of ^{195}Pt NMR for the structure of platinum catalysts, and the use of NMR methods (via line width) for estimating molecular mobility, thus addressing the question of molecular diffusion in catalysts.

Our aim is thus to provide those who work in the field of catalytic science and technology with an account of NMR methods which should prove of relevance to their problems, together with a summary of the existing literature in the light of which the likely application of various NMR methods to future problems may be judged.

Since the present volume is the penultimate one in the series, the opportunity has been taken in Chapter 2 to provide a glossary which gives the meaning of the more commonly used special terms used in catalytic science and technology. Established practitioners in the field will probably find little of novelty here, but the compilation will hopefully be of value to non-specialists coming to the field for the first time.

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