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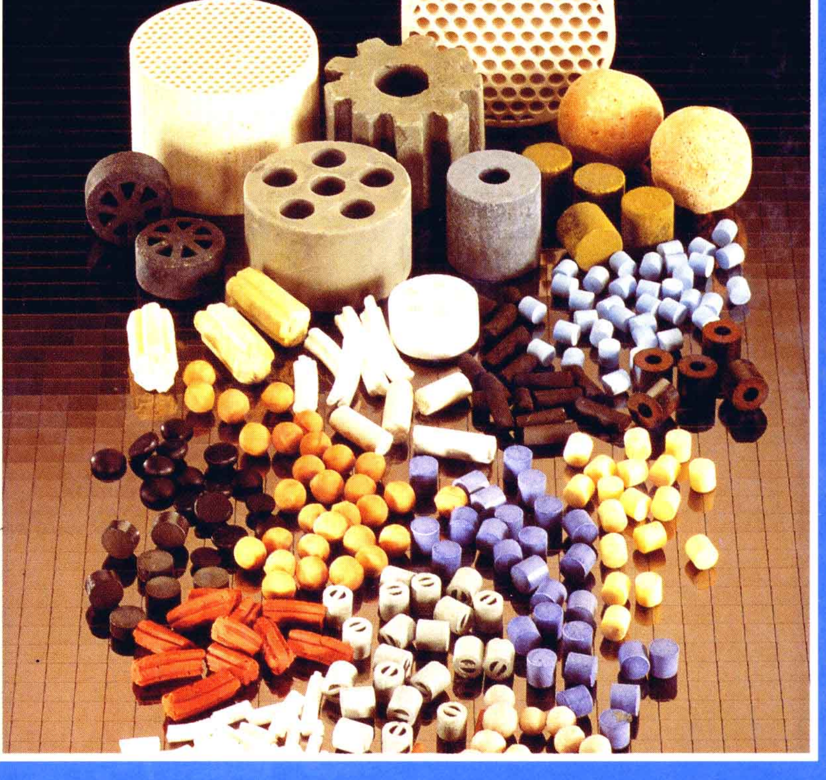

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Foreword

The Handbook of Heterogeneous Catalysis was published in 1997. This book is part of the Handbook, now published as a monograph. Publisher and Editors felt that the Handbook of Heterogeneous Catalysis, which is only available as a full set of five volumes covering almost all aspects of heterogeneous catalysis, might not always be accessible to individuals interested in narrower areas of this field of chemistry. Therefore, the chapters dealing with aspects of preparation of catalysts were selected and put together in this monograph. Catalysis is a rapidly growing field of both academic and technological interest; this Handbook aims to cover the concepts without an encyclopedic survey of the literature, so – although the chapters chosen could not be updated for the present volume – we believe that it will prove most useful to all readers interested in the chemical and physicochemical basis of the preparation of catalysts.

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Contents

1 Introduction

Nature has developed the most efficient and selective catalysts known today. Workers in academia and industry still have a long way to go to reach nature's sophistication in the synthesis of catalysts. For many decades, catalysts were prepared by an empirical approach based on the experience and knowledge of the particular period. Perhaps the best known success story of the development and preparation of a technical solid catalyst by empirical methodologies is that of the ammonia synthesis catalyst by Alwin Mittasch [1–3]. In February 1909 he wrote in his laboratory journal: (i) the search for a suitable catalyst necessitates carrying out experiments with a certain number of elements together with numerous additives; (ii) the catalytic substances must be tested at high pressures and temperatures just as in the case of Haber's experiments; (iii) a very large number of test series will be required [3]. For the optimization of the actual promoted iron catalyst which is still used today, Mittasch ultimately carried out more than 10,000 tests, the number of catalyst formulations exceeding 4,000 [3].

Catalyst preparation lacked a reliable scientific basis until recently and perhaps still does, although catalytic chemists have slowly moved from alchemy to what is now called the science of catalysis. Even in 1940, Raney stated: "It is in the preparation of catalysts that the chemist is most likely to revert to type and to employ alchemical methods. From all evidence, it seems the work should be approached with humility and supplication, and the production of a good catalyst received with rejoicing and thanksgiving" [4, 5].

The catalyst is often, if not always, the heart of a chemical process, and thus, synthesis strategies for technical catalysts are proprietory knowledge of catalyst producers. Therefore, those strategies are either not accessible or protected by patents. This situation, which unfortunately severely hampers the flow of knowledge and information, was strikingly formulated by Richardson: "Catalyst preparation is the secret of achieving the desired activity, selectivity and life time" [6, 7].

Recently combinatorial methodologies were introduced into catalyst development [8, 9]. In this approach, large libraries of materials are synthesized as potential catalysts and examined by microanalysis techniques, and the results are evaluated statistically. This methodology permits an efficient material screening in the case of multi-parameter problems such as the development of solid catalysts. Combinatorial methodologies may be considered as modern versions of Mittasch's approach toward catalyst development that are faster and more cost-efficient than the tradi-