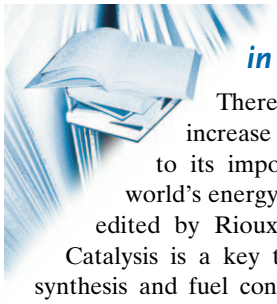

Model Systems in Catalysis

There has been a recent increase in focus on catalysis due to its importance for meeting the world's energy needs, making the book edited by Rioux timely and important. Catalysis is a key technology for chemical synthesis and fuel conversion and the current interest in improving energy efficiency has led to a resurgence of effort in catalysis. The development of new analytical tools and the body of fundamental work in the recent past has advanced our understanding of catalytic reactions and provided an experimental framework for improving efficiency. The understanding of complex catalytic phenomena has advanced considerably and the book edited by Rioux compiles a series of short and excellent reviews on a range of topics that are important in catalysis, spanning heterogeneous and homogeneous systems. The book serves as an excellent introduction and overview, especially for researchers entering the field.

The bulk of the book focuses on heterogeneous systems and most on single-crystal based models. Heterogeneous thermal catalysis, electrocatalysis, and photocatalysis are all touched upon in one or more of the chapters. There are several strong reviews that illustrate both principles and experimental approaches to understanding reactions relevant to catalysis. Generally, the reviews relate the model studies to more complex environments, making excellent connections between the fundamental studies and practical applications. For example, there are a series of chapters on various metals—including pure metals, bimetallic surfaces, and metal carbides and phosphides—that focus on thermal reactivity. These chapters establish important principles, such as the mobilization and restructuring of metal and alloy surfaces in the presence of reactants. Several chapters also establish a clear methodological approach to the investigation of structure–activity relationships in model catalyst systems.

As reflected in the title of the book, Rioux made a major effort to cover a broad range of model systems by including chapters on enzyme catalysis and single-site porous materials that were inspired by enzyme function. The breadth of topics provides some insight into the approaches that are adopted to model and understand catalysis of various sorts. On the other hand, the disparate topics are not generally well integrated and some topics are not covered as extensively as others. For example, theory has played an ever-increasing role in modeling catalytic behavior; yet, there is only one chapter devoted to theoretical approaches. (Several chapters do integrate discussions of theory and experiment, though.) There is only a single chapter on enzyme catalysis, compared to fourteen on extended solids and single crystals. There is also a minimal treatment of homogeneous catalysis; however, homogeneous catalysis is covered well in other reviews and books. Despite the main focus on heterogeneous model systems, it is valuable to include topics such as enzyme catalysis to exemplify approaches that go beyond single crystals and include organic frameworks so as to introduce these topics and connect them to the studies on extended solids.

The book would be stronger if there were a more pedagogical structure, e.g. by organizing the topics in sections with integrating overviews that tie the various chapters together. There is a series of strong chapters on metal oxides that would be further emphasized by an integrating chapter and organization in a single section. The chapter on metal-oxide reactivity and photochemistry that focuses on oxygenates on TiO_2, is aptly followed by one discussing strong metal–support interactions that elegantly illustrates the overgrowth of metal oxides (TiO_2) on metal particles. Two other related chapters on metal-oxide reactivity follow later in the book—an exposition of nanoparticles on metal-oxide thin film models and discussion of the catalysis of thin oxide films and oxide nanoparticles. Each of these chapters focused on a different aspect of the complex nature of metal oxides and their possible contribution to catalysis. Grouping all chapters discussing metal-oxide chemistry together would provide a more cohesive framework and an integrating chapter relating these various chapters would provide a more general context.

In summary, this book provides a useful overview for new researchers in the catalysis field and would provide a useful foundation for a course in the subject. The chapters are generally well written and provide context for the material. Given that a comparable book was not published in at least a decade, this book provides a great starting point to train researchers in model studies of catalysis.

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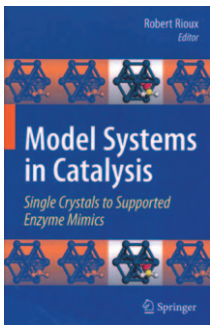
DOI: 10.1002/anie.201005956



Model Systems in Catalysis
Single Crystals to Supported Enzyme Mimics. Edited by Robert M. Rioux. Springer Verlag, Heidelberg 2010. 526 pp., hardcover € 171.15.—ISBN 978-0387980416