



Principles and Practice of Heterogeneous Catalysis

For anyone who has ever ventured into the topic of heterogeneous catalysis, *Principles and Practice of Heterogeneous Catalysis* requires little introduction. In 1997, the book's first edition provided a timely overview of heterogeneous catalysis at the end of a century that spearheaded its establishment as a scientific discipline. Conscious of the spiraling advances in this multidisciplinary field, the authors undertook the commendable task of writing a unified text that would serve both as an instructive guide and as the basis of a common framework for activities in this area, which was accomplished through the creation of this now classical reference text. Taking readers on a journey through the varied facets, Thomas and Thomas matter-of-factly introduce the fundamental pillars of the subject with remarkable breadth and depth, and as such it has rightly found a home on the shelves of undergraduates and researchers worldwide.

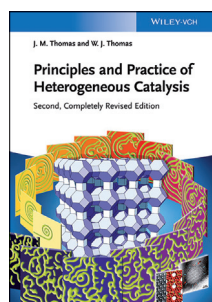
The second edition builds upon the visionary structure and motivation of its predecessor. Actualized over several years, the eight original chapters have seen careful revisions and are now complemented by a new chapter that took into account the many profound changes in heterogeneous catalysis since the late 1990s. The variety of internal (scientific advances) and external (practical and societal) factors which contributed to the developments is outlined in Chapter 1 ("Setting the Scene"). Having revolutionized our knowledge of the chemical processes occurring on solids at the atomic level, a topic which understandably receives a much increased standing is that of computational approaches. In particular, their place alongside experiments is chronicled through exemplary case studies that have established correlations between calculated descriptors and the observed catalyst performance in Chapters 2 ("The Fundamentals of Adsorption") and 5 ("Solid State Aspects of Heterogeneous Catalysis").

Significant advances, enabling the unprecedented spatiotemporal resolution and detection sensitivity of experimental techniques, and the drive towards the analysis under operando conditions have also prompted a majorly restructured presentation of Chapter 3 ("The Characterization of Industrial and Model Solid Catalysts"), which focuses on the techniques that have proven of most value to the catalysis community. Here, the authors make the early distinction between what we often term "research" and "technical" catalysts, and while the former still receive most attention, the need to bridge the gap in complexity is clearly

highlighted. Methods which debut in this edition include improved variants of vibrational spectroscopy and electron microscopy, such as sum frequency generation, polarization modulation infrared reflection absorption spectroscopy, electron crystallography, and electron tomography.

With respect to the catalysts themselves, the book briefly surmises the structures and opportunities brought by novel families of porous solids, most notably new zeolite frameworks and compositions, metal-organic-frameworks, and other mesostructured solids in Chapter 4 ("Porous Catalysts"). However, it is noteworthy that the description of the catalysts only covers key structural features rather than the methods of synthesis. One of the shortest and least touched chapters is Chapter 6 ("Poisoning, Promotion, Deactivation and Selectivity of Catalysts"). Nevertheless, the authors stress that the extremely important role of carbon on catalytic surfaces, which only became apparent of late, will most likely be heard of more frequently in future years. Going hand in glove with catalyst development, progress in reactor engineering has also not escaped thoughtful attention. Shifting trends in modern chemical engineering, particularly those geared towards process intensification through the development of multifunctional reactors, the approach of miniaturization, the move from batch to continuous processing, and concepts as "poly-generation", i.e., the integrated production of chemicals and energy, are now succinctly introduced alongside the mathematical tools to enable the quantitative understanding of reactor design and related process considerations in Chapter 7 ("Catalytic Process Engineering"). This is further addressed in Chapter 8 ("Heterogeneous Catalysis: Examples, Case Histories and Current Trends"), which emphasizes some of the challenges faced in industrial practice and draws attention to recent advances in catalytic membrane processes and devices for water splitting, among others.

As the world population continues to rise, resource management has never been more critical. Catalysis offers a means to maintain the sustainability and economic stability of our society and its role can only be expected to grow. This is reflected by a new chapter aptly entitled "Powering the Planet in a Sustainable Manner" (Chapter 9), that covers concepts and challenges in the search for alternatives to fossil-fuel-based energy and chemical economies. Among these, the widely studied generation of solar fuels, i.e., through artificial photosynthesis or a thermochemical reaction, forecasts for hydrogen- and methanol-based economies, and the development of potential biorefinery platforms feature prominently. Fusing elements of chemo-, bio-, photo-, and electrocatalysis, the examples through which this is elaborated, culminate the book in a thought-provoking way that will



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stimulate the enthusiasm of the novice and more experienced practitioner alike.

Apart from the lifelong experience that the authors imbue, a real asset of the book is its dynamic section structure, which enables the reader to engage with the content at almost any point without knowledge of the preceding sections. Obviously, with the intention for educational purposes, the book does not exhaustively review all of the recent scientific literature, primarily concentrating on more well-established aspects. Even so, the copious citation of more specialized

texts points readers in the right direction to attain a deeper understanding. We are confident that the changes stand the second edition in good stead to endure as a key reference for the decades to come.

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