Catalysis for Sustainable Energy Production

This book of 13 chapters, organized in four parts ("Fuel Cells", "Hydrogen Storage", "Production", and "Industrial Catalysis for Sustainable Energy Production"), contains a collection of contributions from a workshop organized in Italy in late 2006 by members of the EU-funded "network of excellence" on catalysis, IDECAT (Integrated Design of Catalytic Nanomaterials for Sustainable Production). The book is a useful research and teaching tool, despite the fact that it suffers from a number of flaws. First, one wonders why a slim but informative chapter on photovoltaics—concluding with just five references, four of which refer to web pages—was inserted in a book dealing with catalysis. The first claim of the Foreword tells us that, "no matter what the energy source is—oil, natural gas, coal, biomass, solar", a sustainable energy future will involve catalysis. However, no catalytic process is involved in the production of photovoltaic solar cells of the first and second (thin-film) generations.

The chapters on electrocatalysis for water electrolysis, materials for hydrogen storage, and the design of catalysts for reforming of oxygenates are truly excellent treatments of their topics. Their completeness and depth will ensure that these chapters continue to serve as reference sources for future research. Chapter 9, on methane reforming for distributed production of hydrogen, is also of particular interest because of the versatility and the advanced state of the technology described by the authors. Finally, Chapter 12 on catalytic combustion of methane in gas turbines to produce heat and electricity gives a brief but excellent outline of a technology that has recently been commercialized.

With the help of many high-quality images, drawings, and microphotographs, and some 45 chemical and mathematical equations, Züttel explains the principles and the main approaches used to compress and store hydrogen to make it readily available when and where it will be needed in the decentralized energy scenario of tomorrow. Fornasiero and Rogatis do the same for organic oxygenates, many of which are obtained from biomass, opening the way to the future bio-refinery wherein heterogeneous catalysts are used to convert abundant and cheap substrates into high-value compounds for a wide variety of uses. Trasatti and Guerrini, use only a single graphic, and report on the state of the art of available technologies for water electrolysis, which in the post-Kyoto future of zero carbon emissions will play a crucial role. In particular they describe the coupling of photovoltaic cells with highly efficient electrocatalysis in membrane electrolyzers, affording pure hydrogen in quantitative yield.

In Chapter 4, researchers in an auto manufacturing company explain why and how, for the first time, full electric mobility has become possible. Again, very little catalysis is involved in this progress. However, readers are told that a small car of the type commonly sold in Europe, with its 3.5 m^2 outer surface coated with 12 %-efficient thin-film solar cells, would be capable of generating between 1.52 kWh and 2.27 kWh per day in Italy, depending on the available radiation (Northern, Central, and Southern Italy). The higher figure is enough energy to power the car for the range traveled daily by 80 % of users (20 km). An aerodynamic factor SC_x is applied throughout the chapter, but it is never defined, and at times the factor is even omitted.

Toshiba announced commercialization of its methanol fuel cell for laptop computers in 2005, but the methanol-powered laptop never entered the market. Thus, a reader interested in direct methanol fuel cells for portable power applications (Chapter 2) can benefit from the author's insight into the technical and economic reasons that have, up to now, hampered commercialization of methanol-based fuel cell batteries. The interesting Chapter 3 on carbon nanofibers as catalyst supports for low-temperature fuel cells could perhaps have offered an answer to those problems. However, the absence of such insight points to a general lack of practical and economic information which is common to many scientific meetings organized by academics; in particular the lack of effective collaboration between academic and industrial research groups is one of the objectives of the IDECAT network.

Catalysis is a major field of research of the science of chemistry, but is not a science in itself. This book and the members of the IDECAT research community call for a new approach to catalysis centered around the need to "create a strong cultural thematic identity on nanotech-based catalysts". Apart from the circularity of the argument (catalysis cultural identity based on catalysts), many of the flaws of this book come from this single misconception that catalysis alone will lead to a sustainable common future. Nanochemistry is actually providing many of the solutions needed to accomplish this major shift. And many of the best pages of this book deal with nanochemistry-enabled nanotechnologies.

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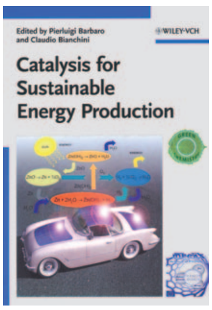

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