Environmental Engineering and Management Journal *September/October 2008, Vol.7, No.5, 647-648*
http://omicron.ch.tuiasi.ro/EEMJ/

"Gh. Asachi" Technical University of Iasi, Romania

Book Review

HANDBOOK OF HETEROGENEOUS CATALYSIS

Second, Completely Revised and Enlarged Edition

Volume 4

Gerhard Ertl, Helmuth Knözinger, Ferdi Schüth, Jens Weitkamp (Editors)
Wiley-VCH Verlag GmbH& Co. KGaA, Weinheim, Germany,
ISBN: 978-3-527-31241-2, 2008

The fourth volume of the **Handbook of Heterogeneous Catalysis** is organized in four sections: *Activity Loss*, *Special Catalytic Systems, Laboratory testing of Solid Catalysts* and *Reaction Engineering*.

The first chapter (***Activity Loss***) deals on the one hand with the Deactivation and Regeneration of catalysts and on the other hand with the Recycling of Spent Catalysts, especially those containing precious metals and base metals. Because the catalysts deactivation is a topic of real interest particularly for industrial applications, the subject has been reviewed in this chapter of the Handbook; the causes of the catalyst deactivation as well as what are the solutions of the catalyst regeneration are adequately presented. Due to their importance, the recycling of the catalysts containing precious metals as well as those containing base metals can generally be performed economically and is already successfully practiced in many applications area. Consequently, this sub-chapter briefly introduces the main groups of these catalysts and highlights (i) their important applications and (ii) recycling technologies depending on the individual characteristics of the catalysts.

Because of the diversity of chemical nature of the catalytic materials, special catalysts or catalytic systems have been developed. Accordingly, the second chapter, on ***Special Catalytic Systems***, reviews the main relevant fields of catalysis. Electrocatalysis deals with the reactions in which a charge transfer across the interface between electrode and electrolyte takes place.

In this sub-chapter the basic principles of electrolysis are reviewed: (i) the structure of the electrode/electrolyte interface and the driving force for charge transfer at electrodes, (ii) the main kinetic parameters and their relationship to mechanisms and (iii) basic concepts of electrocatalysis. Further, the electrocatalytic reactions occurring at the hydrogen electrode and the oxygen electrode are considered. The sub-chapter ends with a discussion on the importance of industrial electrolysis on the basis of the some commercially relevant examples from the fields of both organic and inorganic chemistry. The multiple environmental problem caused by the fast economical growth in the last centuries induced the necessity to develop environmentally friendly chemical processes and systems such as Photocatalysis. This sub-chapter is devoted to the most applied photocatalyst, TiO_2; ion engineering techniques for the preparation of well-defined as well as visible light-responsive TiO_2 photocatalysts are reviewed. The sub-chapter Chemical Sensors Based on Catalytic Reactions starts with useful definitions and classifications of sensors, followed by few commonly used chemical sensors examples such as amperometric gas sensors, lambda probes, Taguchi SnO_2 sensors, pellistors, biosensors to monitor of oxygen in blood and Pd-gate field effect transistors. The next sub-chapter, on Heterogeneous Catalysis in Non-Conventional Solvents focuses on non-conventional solvents as opposed to conventional liquid or gaseous reaction media for heterogeneously catalyzed conversions. The non-conventional solvents treated here include supercritical fluid, ionic liquids and gas expanded liquids. Also, examples of reactions performed in these kinds of solvents are well

documented herein such as hydrogenations and dehydrogenations, oxidations, Fischer-Tropsch synthesis etc. Other recently study options for reactions media such as polyethylene glycols, perfluorohydrocarbons and thermoregulated solvent systems have only rarely been exploited in heterogeneously catalyzed reactions and are, therefore, only briefly mentioned. Due to the fact that ultrasound became a common laboratory tool for nearly any case where a liquid and a solid must react, the last sub-chapter is devoted to Sonocatalysis. A comprehensible introduction on the origins of sonochemistry followed by the effects of ultrasound on heterogeneous catalyst can be found in the Handbook.

The third chapter, on ***Laboratory Testing of Solid Catalysts***, is divided in three sub-chapters. The first sub-chapter (Laboratory Catalytic reactions: Aspects of Catalytic Testing) is focused on (i) the reactor systems, which introduces a classification of the rectors as well as the types of the reactors used in the laboratory; (ii) mass and heat transfer; (iii) effect of transport limitations on observed behavior; (iv) diagnostic experimental tests for extraparticle and intraparticle limitations to verify the presence or absence of transport limitations; (v) proper testing of the catalysts in order to obtain the relevant information with regard to intrinsic activity, selectivity, deactivation and kinetic behavior and finally, (vi) current trends in catalyst testing, which supposes to scaling down the reactions to micro-and nano-flow with full automation. The intention of the sub-chapter Ancillary Techniques in Laboratory Units for Testing Solid Catalysts is to discuss critical building blocks of laboratory-scale catalytic units which are frequently designed in an inadequate manner.

Essentially, this sub-chapter is focused on the peripheral building blocks, that is, the devices for the preparation of the feed mixtures to be sent to the reactor and the systems downstream of the reactor for transferring product samples to an analytical instrument.

High-Throughput Experimentation in Heterogeneous Catalysis is a relatively novel technology in the development of heterogeneous catalysts. Consequently, this sub-chapter gives an analysis on the different elements of an HTE program in heterogeneous catalysis starting with the presentation of a typical program and going on with the technology elements that covers (i) aspects of the synthesis, (ii) characterization tools, (ii) reactors and analytics and finally, (iii) informatics environment, required for a fully integrated high-throughput program.

The last chapter, on ***Reaction Engineering***, is devoted to the chemical reactors and it is organized in eight sub-chapters as follows: Catalytic Fixed-Bed Reactors, Fluidized-Bed Rectors, Slurry Reactors, Unsteady-State Reactors Operation, Short-Contact Time Reactors, Catalytic Distillation, Catalytic Membrane Reactors and Microstructured Reactors. The aim of this chapter is to illustrate some of the fundamental characteristics of each type of the reactor used so far. Typical industrial applications using select examples from the literature, kinetic models and approaches to the modeling and designing of a particular catalytic reactor are adequately discussed, as well.

Brandusa Dragoi
Cezar Catrinescu
Faculty of Chemical Engineering
and Environmental Protection
"Gh. Asachi" Technical University of Iasi,
Romania