

Editorial

Zeolite Catalysis

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Academic Editor: Keith Hohn

Received: 23 July 2016; Accepted: 27 July 2016; Published: 2 August 2016

1. Background

The Special Issue “Zeolite Catalysis” published in the online journal *Catalysts* was recently successfully completed. A good number of peer-reviewed publications were published reflecting the broadness of the zeolite syntheses, characterizations and various application fields. This issue brought together recent research of well-known research teams from all over the world.

The term “zeolite” is based on the Greek words for “to boil” and “stone” and it has been known since 250 years ago. At that time, the Swedish mineralogist, A.F. Cronstedt (1722–1765), observed the formation of a large amount of steam when heating the material Stilbite which indicated its porous character and adsorption capacity. At present, over 200 different zeolite frameworks have been identified. In general, zeolites are crystalline aluminosilicates with a defined micropore structure. Within zeolites, a good number of elements can be isomorphously incorporated and much more elements or their oxides can be hosted by zeolites. In addition, zeolites comprise a large variety in size of pore mouths, channels, crossings, etc. leading also to their designation as molecular sieves and use in membrane applications. Nowadays, various hierarchical and composite materials are designed offering further interesting properties, e.g., by the introduction of mesopores or generation of fibers. Zeolites reveal Brønsted and Lewis acidic properties that can be varied in wide limits as well. Thus, they deserve the name “solid acids”. Zeolites have an immense importance in diverse industrial applications such as catalysts and adsorbents, for example in the refinery industry, chemical industry, detergent sector or for solar thermal collectors and adsorption refrigeration.

2. This Special Issue

The aim of the Special Issue was directed to new developments and recent progress with respect to zeolite-catalyzed chemical reactions, adsorption applications and membrane uses, as well as improved syntheses strategies and characterization techniques. Xuan Hoan Vu and colleagues [1] reported on the synthesis of novel ZSM-5 containing hierarchical composites and their use in catalytic cracking of triglyceride-rich biomass to lower olefins. It could be proven that the yield for propene and butenes can be increased using such composites. Aixia Song et al. [2] studied the adsorption and diffusion properties of zeolite Beta using three xylene isomers. Adsorption isotherms from microporous and mesoporous zeolite Beta were recorded showing the impact of mesopores on adsorption properties. Houbing Zou and co-workers [3] reported on facile synthesis of yolk/core-shell structured TS1@mesosilica composites, catalytic properties were checked in the challenging hydroxylation of phenol. The catalyst characterizations showed a high surface area of 560–700 m²/g and a hierarchical pore structure with mesochannels and micropores. In comparison to well-known TS-1, the synthesized solids reveal enhanced activity at comparable selectivity. The research group of Fabrizio Cavani [4] contributed to the Special Issue with an article on the use of zeolite catalysts for phenol benzylation with benzoic acid. The aim of this work was the synthesis of hydroxybenzophenons which are important intermediates in the chemical industry. H-Beta zeolites offer superior performance compared to H-Y solid. The studies were supported by various mechanistic insights. Radostina Dragomirova and Sebastian Wohlrab [5] extensively summarized the application of zeolite membranes in catalysis.

The detailed review is backed by ca. 300 references on zeolite membrane preparation, separation principles as well as basic considerations on membrane reactors. The given classification according to membrane location considers: (i) membranes spatially decoupled from the reaction zone; (ii) packed bed membrane reactors; (iii) catalytic membrane reactors; and (iv) zeolite capsuled catalyst particles. Ceri Hammond and Giulia Tarantino [6] reported on post-synthesis modifications of TS-1 to suppress undesirable H_2O_2 decomposition in hydroxylations. Ti site speciation changes were observed by in-situ spectroscopic techniques. Takashi Tatsumi and colleagues [7] in their contribution described effects of dealumination and desilication of Beta zeolite and the consequences for their catalytic performance in *n*-hexane cracking to propene. Dealumination was carried out by HNO_3 treatment; desilication was obtained by alkali treatment. The propene selectivity at high *n*-hexane conversions was increased after alkali treatment followed by acid treatment. This is due to: (i) the decrease in number of acidic sites; and (ii) by an increase in number of mesopores which are beneficial to the diffusion of coke precursor compounds. Jing Han et al. [8] reported on the manufacture of $\text{Ga}_2\text{O}_3/\text{ZSM-5}$ hollow fibers for use as efficient dehydrogenation catalysts for *n*-butane conversion. Light olefin yields could be increased significantly compared to Ga_2O_3 , ZSM-5 fibers and GaO_3 supported on ZSM-5. Guozhu Liu and coworkers [9] in their article showed the catalytic properties of Pt/H-ZSM-5 in the conversion of lignin-based phenols into xylene isomers. The addition of methanol to the reaction mixtures leads to increased xylene yields. The impact of MeOH addition is attributed to the combined action in both the reaction pathways: methylation of *m*-cresol into xylenols followed by hydrodeoxygenation to form *p*-/*m*-xylene, and hydrodeoxygenation of *m*-cresol into toluene followed by methylation into *p*-/*m*-xylene. Alessandra Silva et al. [10] reported on the synthesis of ZSM-5 zeolites using biomass such as sugar cane bagasse as structure directing agent. MFI crystals with different morphologies were obtained that were different from the pristine zeolite formed in the absence of biomass. The research team of Roger Gläser [11] contributed to the Special Issue with a report on photocatalytic oxidation of NO over $\text{TiO}_2/\text{ZSM-5}$ composites. Various composites were synthesized using different TiO_2 sources. The highest NO conversion of ca. 40% was obtained with a catalyst from sol-gel synthesis with equal amounts of the two components after calcination at 250 °C.

This short survey proves the potential of zeolites and zeolite-based materials in modern catalysis and related research areas. I have no doubt that further articles on the above mentioned topics will be published in *Catalysts* soon.

Conflicts of Interest: The author declares no conflict of interest.

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