NEW FINDS FOR NANOSIZED ZEOLITES DIRECT NOVEL APPLICATIONS

Svetlana Mintova

Laboratoire Catalyse & Spectrochimie, ENSICAEN - Université de Caen - CNRS

6, boulevard Maréchal Juin, 14050 Caen, France

E-mail: svetlana.mintova@ensicaen.fr

This presentation highlights recent developments in the synthesis and unconventional applications of nanosized zeolites. The great interest in nanosized zeolite is due to their particular structures and related properties, such as accessible intracrystalline volume and thus much larger specific surface area in respect to dense materials. The presences of channels with molecular dimension and active sites that can be tuned make these materials excellent heterogeneous catalysts and molecular sieves. Although zeolites are with high specific surface area and accessible crystalline volume the size of zeolites is important for their performance. Separation and catalytic transformation of different species (ions, molecules) are based on surface reaction with atoms situated at the surface of a sold material. Thus the number, nature and distribution of the active centres are of paramount importance for the efficiency of the process. Moreover the decrease of microporous crystals size could substantially limit the impact of diffusion limitations. Thus, the preparation of nanosized crystals is important to improve the performance of microporous materials in a number of processes.

The crystallization kinetics' of several types nanosized zeolites synthesized with and without organic templates will be discussed. The most promising approaches from the viewpoint of large-scale production of nanosized zeolites will be discussed in depth. The emphasis will be on the nature and mode of mixing of the initial reactants resulting in the formation of amorphous particles with different physical appearance. The starting materials have the governing role for the formation of amorphous particles and intermediates that are specific for each system.

Also it is important to differentiate between 'free' and 'fixed' nanoparticles that can be considered for different applications. The nanoparticles can be designed intentionally via "synthesis engineering" or the nanoparticles can be prepared by post-synthesis treatments. In this presentation, the importance will be on *in situ* prepared nanosized zeolites, the preparation and advanced application of both free and fixed nanosized zeolites. Further the presentation will be accentuated on the new, non-conventional for porous materials, applications. A comprehensive analysis of the emerging applications of microporous nanosized crystals in the fields of semiconductor industry, optical materials, chemical sensors, medicine, cosmetics, and

food industry will be presented.

Finally, the future needs and perspectives for nanosized microporous materials will be addressed.

Substantial progress has been made in the nanosized zeolite processing using template free precursor suspensions resulting in highly crystalline materials with yield comparable to commercial micronsized zeolites. Between the 220-zeolite structures available now, 19 are prepared with nanosized dimensions. They reveal tunable crystals size, chemical composition, diverse morphology, large external surface area, fast diffusion, high stability in suspensions and no toxicity, which resulted in new applications.

The unique properties of the nanosized zeolites in free or fixed forms make them ideal candidates for nanotechnology applications. The nanosized zeolites, starting from raw materials, synthesis process, their application and finally wastes are exposed to human *via* inhalation, skin or swallowing. Therefore information on the toxicity of nanosized zeolites prior further application is of great interests. The low cytotoxic activity of nanosized zeolites with different sizes, compositions and shapes were reported and this is expected to enlarge their future industrial and medical applications. Zeolite materials have been considered for medical use due to their stability in biological environments. Based on the advantages such as small size and controlled release, zeolite modified with targeting molecules are recognized for application in controlled drug and gas targeting treatments. Additionally zeolite nanocrystals are also investigated as positive magnetic resonance imaging agents, and enzyme-immobilizing carriers. Nanosized zeolites have been studied as dietary supplements, antimicrobial agents, or adjuvants in anticancer therapy.

Intelligence can determine the physical form and allows for proper self-assembly of the elements, thus extending the family of nanosized zeolites by understanding the growth mechanism is envisioned. The zeolites are expected to play an ever-increasing role in the design of next generation of devices and especially in medical, food and cosmetic industries.

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