X-ray amorphous zeolites

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Improving the accessibility to zeolite active sites and processing bulky molecules are amongst the most important challenges of zeolite science and practice. Extra-large pore zeolites were synthesized by employing Ge as co-structure directing agent, but these materials are not useful for practical uses because of low hydrothermal stability. The use of nanosized zeolite crystals or the introduction of larger (meso- and/or macropores) in conventional zeolite crystals and thus decreasing the size of crystalline domain containing solely micropores are the two approaches that are expected to provide much better performing zeolites.

The introduction part of the talk is devoted to the synthesis of nanosized zeolite crystals. Namely, the preparation of nanosized crystals from conventional hydrogel systems that are employed in the industrial production of zeolites will be addressed. Besides the physicochemical properties of zeolite crystals, important issues as crystalline yield, level of aggregation and colloidal stability of zeolite nanoparticles will be discussed.

The main part of the presentation discusses the preparation of zeolite units that do not exhibit long range order. The possibility to obtain solid zeolite-type catalysts that contain only short range and thus more open structure will be exemplified by the preparation of FAU-type and CHA-type zeolite precursors. In the case of FAU-type zeolite the crystal growth kinetics is used as a tool for controlling the size of zeolite units. Different approach, namely the use of specific aluminosilicate precursors that limit the growth because of charge mismatch in the structure is used in the preparation of CHA-type zeolite units. The final products and their intermediates are studied by complementary physicochemical methods. The nano-sized FAU-type zeolite and the X-ray amorphous precursors are tested as solid-base catalysts in the Knoevenagel reaction.

The industrial perspective for a zeolite material requires a simple treatment that avoids consecutive steps and special equipment. The presented approach face this condition, hence it is expected that both nanosized and X-ray amorphous zeolites could face the industrial challenges in terms of cost and simplicity of processing.

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