J. Heyrovský Institute of Physical Chemistry, v.v.i.

3rd Prague Zeolite Day

September 25, 2012

10^{00} - 11^{00} Sang-Eon Park
11^{00} - 11^{20} Coffee
11^{20} - 12^{20} Matthias Thommes

Roles of Mesoporosity of Hierarchical MFI Zeolites Assembled by Microwave

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Physical Adsorption Characterization of Micro/Mesoporous Molecular Sieves with Hierarchical Pore Structure

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There have been big rush to synthesize hierarchical zeolites in order to take advantages and overcoming drawbacks of both microporous and mesoporous molecular sieves. Nowadays, many strategies have been proposed but mostly rely on demetallation and porogens for the developing mesoporosity onto zeolitic single crystals. We've synthesized mesoporous zeolites having MFI framework topology (Silicalite-1, TS-1 and ZSM-5) containing both structured microporosity and secondary mesoporosity inside of zeolite single crystals through the assembly of MFI nanoparticles by using microwave. These types of hierarchical MFI zeolites could exhibit high catalytic activities of bulky reactants with the enhanced catalytic stabilities in various acidic and oxidative catalytic reactions such as alkylation, cracking, condensation, and epoxidation but give reverse shape-selectivity due to the presence of mesoporosity [1].

Here, microwave assembled and induced mesoporous ZSM-5s were demonstrated to be effective for the generation of mesopores by supramolecular self-assembly and carbon templating, and detitanation, respectively. Because microwave synthesis [2] could enforce the assembly through the ionic interaction between sulfonic acid functionalized MFI zeolite nanoparticles and counter cationic surfactant (CTAB) [3], and carbon of a good MW absorber was used as a hard template [4], and Ti-containing MFI was selectively absorbing microwave to be easily detitanated to form mesoporosity, respectively.

Besides above typical roles of mesoporosity, another important role of mesoporosity in the hierarchical ZSM-5 was illustrated to accommodate chiral complexes [5] or chromophores like porphyrin and phthalocyanine into the confined spaces to be applied to chiral catalysis or photocatalysis, respectively.

References

[1] H. L. Jin, S. -E. Park, *J. Catal.* **2012**, *In press*.
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[3] H. L. Jin, S. -E. Park, *Chem. Commun.* **2011**, *47*, 7482.
[4] J. -B. Koo, S. -E. Park, *J. Catal.* **2010**, *276*, 327.
[5] N. H. Khan, S. -E. Park, *Tetrahedron Asym.* **2011**, 22, 117.

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A comprehensive textural characterization of novel nanoporous materials has become more important than ever for the optimization of novel systems used in many important existing and potentially new applications. The most popular method to obtain surface area, pore size, pore size distribution and porosity information from powders and porous solids is gas adsorption. However, despite the recent progress achieved in the understanding of the adsorption mechanism of fluids in highly ordered mesoporous materials with simple pore geometries (e.g., M41S materials), there are still many open questions concerning the surface and textural characterization of more complex porous systems. Within this context we review recent progress in the field of physical adsorption characterization and will address important questions associated with the structural analysis of zeolitic materals with hierarchical pore structure. In addition to pore structure analysis we also address the challenges associated with the assessment of surface properties.