Hierarchical zeolites: Enhanced utilisation of microporous crystals in catalysis by advances in materials design - DTU Orbit (14/11/2019)

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The introduction of synthetic zeolites has led to a paradigm shift in catalysis, separations, and adsorption processes, due to their unique properties such as crystallinity, high-surface area, acidity, ion-exchange capacity, and shape-selective character. However, the sole presence of micropores in these materials often imposes intracrystalline diffusion limitations, rendering low utilisation of the zeolite active volume in catalysed reactions. This critical review examines recent advances in the rapidly evolving area of zeolites with improved accessibility and molecular transport. Strategies to enhance catalyst effectiveness essentially comprise the synthesis of zeolites with wide pores and/or with short diffusion length. Available approaches are reviewed according to the principle, versatility, effectiveness, and degree of reality for practical implementation, establishing a firm link between the properties of the resulting materials and the catalytic function. We particularly dwell on the exciting field of hierarchical zeolites, which couple in a single material the catalytic power of micropores and the facilitated access and improved transport consequence of a complementary mesopore network. The carbon templating and desilication routes as examples of bottom-up and top-down methods, respectively, are reviewed in more detail to illustrate the benefits of hierarchical zeolites. Despite encircling the zeolite field, this review stimulates intuition into the design of related porous solids (116 references).

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