Seminář odd. 26
Tenkých vrstev a nanostruktur

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TÉMA

Zeolites: From 3D to 2D Materials

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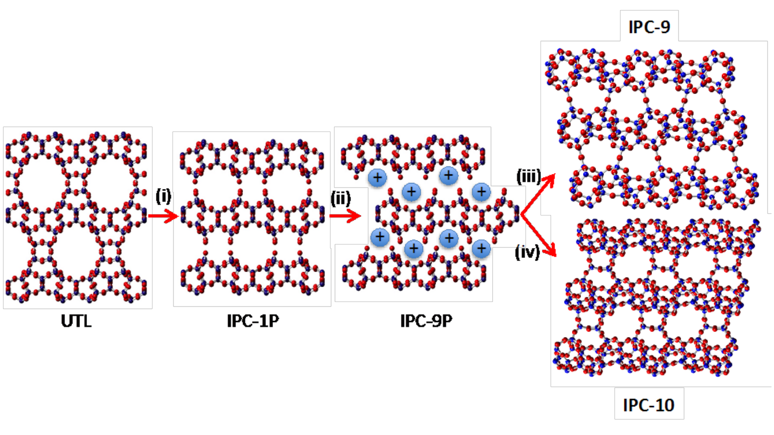
The name zeolites, coined in 1756 and meaning 'boiling stones', refers to a diverse but uniform class of natural and synthetic crystalline aluminosilicates and related compositions with framework structures containing well-defined nanopores, which can adsorb and discriminate molecules based on size and shape. They are widely used in the petroleum and chemical industries because of exceptional catalytic and selective adsorption properties in combination with thermal and chemical stability as well as environmental friendliness, exemplified by their use in detergents. Their niche applications include medical treatments, gas pollution abatement and membranes with the potential for a breakthrough for CO_2 separation. Zeolites crystallize readily and spontaneously under hydrothermal conditions from suitably adjusted synthesis mixtures. There is a continuous ongoing effort to discover new framework structures, to expand and improve applications and to gain better fundamental understanding, which is now primarily empirical. The traditional zeolites have been conceptualized as 3D networks but a recent breakthrough revealed their formation as crystalline layered solids[1], which has had far reaching implications, e.g. creation of expanded architectures.[2]

This lecture will be divided into two parts. The first one will provide general information about zeolite structures, properties, applications and their synthesis approaches. The second part will focus on a novel synthetic protocol for the synthesis of new zeolites and related materials involving breaking down a 3D zeolite framework into layers and reassembly into another ordered 3D structure. It has been named ADOR mechanism (Assembly – Disassembly – Organization – Reassembly) and will be presented from both experimental and theoretical perspectives.[3] ADOR has been developed for the synthesis of novel feasible and "unfeasible" zeolites and related expanded pillared materials having the same structure of the zeolitic layers but various connectivities. The principal step of the ADOR process is hydrolysis of parent germanosilicate frameworks with inherent bonding weaknesses providing layered precursors for further chemical manipulation based on intercalation and interlayer reactions. The products can be pillared materials with organic or inorganic pillars or new zeolites, some of them with unprecedented energetic features. Syntheses and structures of new materials prepared from parent UTL and UOV zeolites will be discussed.



References:
[1] Roth, W. J.; Čejka, J., Two-dimensional Zeolites: Dream or Reality? Catalysis Science & Technology 2011, 1, (1), 43-53.
[2] Roth, W. J.; Nachtigall, P.; Morris, R. E.; Čejka, J., Two-dimensional zeolites: current status and perspectives. Chemical Reviews 2014, 114, (9), 4807–4837.
[3] Morris, R. E.; Cejka, J., Exploiting chemically selective weakness in solids as a route to new porous materials. Nature Chemistry 2015, 7, (5), 381-388.

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