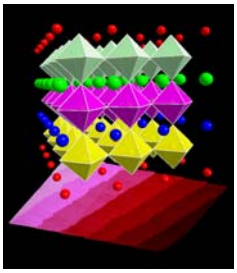
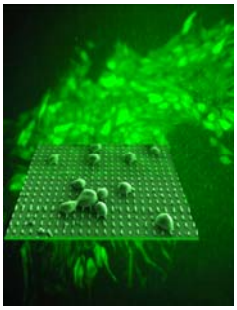
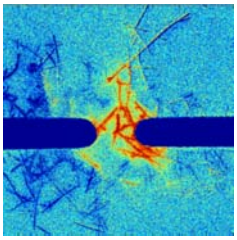
CNMS DISCOVERY SEMINAR SERIES

Friday, April 4, 2008
2:00 pm
Iran Thomas Auditorium, 8600
Light refreshments will be served







"Zeolites with Mesopores and Mesoporous Zeolites"

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Abstract:

Shape-selective reactions are of great importance because they allow reactions to occur with high selectivity, thus avoiding separation steps and waste product formation. A shape-selective reaction can occur in the pores of a zeolite, but the diameter of the molecule should not be much smaller than the pore diameter. This automatically means that the reaction rate may become diffusion limited and that the chance for intermolecular reactions, and thus the formation of unwanted byproducts, increases. The solution to this problem is to create mesopores in addition to the zeolite micropores, so that the molecules stay less long in the micropores. Already several decades ago, mesopores were created in zeolites by acid leaching and for zeolites Y and mordenite this has even led to commercialization. Recently, basic leaching was shown to give more mesoporosity than acid leaching.

The discovery of the mesoporous materials MCM-41 and SBA-15 created the hope that hierarchical materials, that contain micro- as well as mesopores, can be synthesized by design, instead of by random leaching. Several strategies to enhance the acidity and hydrothermal stability of mesoporous materials have been developed, but the acidity of the resulting materials was still lower than of zeolites. In the past years, synthesis methods have been published of real hierarchical zeolitic materials. Carbon particles, amphiphilic organosilanes, silylated polymers, and mesoscale cationic polymers have been used as secondary template. After hydrothermal synthesis, the secondary template is burned away, leaving mesopores behind.

We prepared mesoporous ZSM-5 by using an amphiphilic organosilane as secondary template. XRD, nitrogen adsorption, and ^{27}Al and ^{28}Si MAS NMR measurements demonstrated that it contained both micropores and mesopores and the isomerization of 2-methyl-2-pentene showed that it had similar acidity as ZSM-5. Due to the presence of mesopores, the mesoporous ZSM-5 had a much higher activity in the Friedel-Crafts benzylation of benzene by benzyl alcohol than conventional ZSM-5 and amorphous silica-alumina. Also Pt and Pd supported on mesoporous ZSM-5 gave much higher hydrodesulfurization activities than Pt and Pd supported on conventional supports.

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