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FAKULTÄT FÜR CHEMIE

Einladung zum Vortrag von

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Catalysis inside a box

Supported metal nanoparticles are usually synthesized by ion-exchange or wetness impregnation on porous carriers. Unfortunately, sintering of nanoparticles usually occurs in reaction conditions leading to particle growth and eventually to a degradation of physical properties. Encapsulations of metal particles in a microporous support have been presented as a solution against sintering since the porous scaffold may limit particle diffusion and eventually their coalescence. However, the efficiency of this approach is limited as the size of the pore is usually larger than the size of the particle. Furthermore diffusional limitation becomes very likely when sub-nanometric microporous support are in play. Recent developments in zeolite materials with hierarchical porous structures for which the mean diffusion path is considerably reduced offers new perspectives in Catalysis by metals. We present general concepts for the synthesis of hollow zeolites and original hollow silicalite-1 and ZSM-5 single crystals with thin and controlled shell thickness. We will describe a generic process for synthesizing bimetallic nanoparticles encapsulated in hollow zeolites, yielding yolk-shell type materials. The originality of the synthesis design is that the hollow zeolites act as nanoreactors in which the bimetallic particles are formed. The here presented process allows controlling the size (2-10 nm) and compositions of NPs which are factors that ultimately determine the catalytic properties. A series of mono- (Au, Pd, Pt) or bi- (AuAg, PdAg, PtAg and PdPt) metallic nanoparticles individually encapsulated in hollow silicalite-1 single crystals have been prepared and characterized. We will also show the encapsulation of base metal nanoparticles (Co, Fi, Fe) and bimetallic particles (FeCu, NiRh,…). With these model catalysts in hands, we will revisit key aspects in Catalysis by metals (selective hydrogenation, oxidation, reforming, Fischer-Tropsch): (i) activity through the design of bimetallic particles of controlled composition, (ii) stability thanks to the encapsulation of nanoparticles in ultra-microporous shells, which prevent sintering by coalescence even under harsh conditions, (iii) diffusional limitation of reactants/products can be prevented due to the very thin porous protective shell (5-20nm), and (iV) selectivity which here is essentially governed by the permeability properties of the zeolite shell (molecular sieving, selective adsorption, diffusional selectivity).

Freitag, 19. Oktober 2018, 15:15 Uhr
Seminarraum 2 der Fakultät für Chemie
Währinger Straße 42, 1090 Wien

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