

TECHNOLOGY OFFER: SIZE SELECTIVE CATALYSIS IN METAL CATALYSIS BY MOLECULAR SIEVING IN MEMBRANE NANOREACTOR

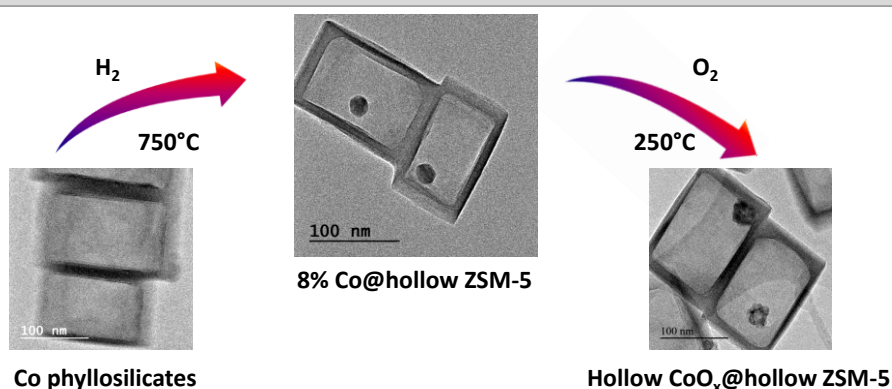
OVERVIEW

Category: Membrane , Catalyst , Reactor , Process , R&D knowledge , Other

Benefit summary: Encapsulated size-controlled metal nanoparticles in hollow zeolite boxes can be applied as catalyst under conditions where reactant discrimination by molecular sieving or control of metal sintering is highly relevant.

Development status: Proof of concept at laboratory scale

IP status: Public



NOVELTY

- Technology benefit description:** The encapsulation of very well sized controlled metal nanoparticle in hollow zeolite boxes allow reactant discrimination by molecular sieving as substrates larger than trimethylbenzene (0,7nm) cannot diffuse through the zeolite shell. This catalyst design shall be relevant against poisoning issues.
- Technology uniqueness and comparison vs state-of-the-art:** Noble metal (Pt, Pd, Au, Ag) and respective alloys of controlled size and composition can be protected by a 20nm thin zeolite layer. Compare to a macroscopic thick zeolite layer on a Pt-alumina bead (1-5mm diameter), this technology prevents sintering issues as nanoparticles are isolated from each other.

DEVELOPMENT

- Technology Readiness Level:** TRL 1 ; 2 ; 3 ; 4 ; 5 ; 6 ; 7 ; 8 ; 9
- Development status:** the synthesis is demonstrated at laboratory scale (50g)

TECHNOLOGY PROVIDER

- Technology provided by:** CNRS at IRCELYON department.
- Related expertise:** Synthesis of hierarchical porous zeolites, synthesis and characterization of metal and alloy nanoparticles, catalysis by metal (hydrogenation, oxidation, reforming, Fischer-Tropsch,...)

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TECHNICAL DETAILS

- **Description:** Noble metal and transition-metal nanoparticles (Co, Ni, and Cu) encapsulated in hollow zeolite single crystals are prepared by recrystallization of impregnated bulk MFI crystals in the presence of TPAO. Metal loadings to ~8 wt% are obtained with mean particle sizes of 17 ± 2 nm, 13 ± 2 nm and 15 ± 2 nm for Co, Ni and Cu system, respectively. The size selectivity by molecular sieving was demonstrated on Pt@zeolite and on Ni@zeolite in the catalytic hydrogenation of substituted benzenes. Metal particles are accessible to toluene but not to mesitylene confirming that the activity is directly related to the diffusion properties of molecules through the zeolite membrane.
- *Size-selective hydrogenation at the subnanometer scale over platinum nanoparticles encapsulated in silicalite-1 single crystal hollow shells*, S. Li, T. Boucheron, A. Tuel, D. Farrusseng and F. Meunier, Chem. Commun., 2014,50, 1824-1826 - DOI: 10.1039/C3CC48648F
- *Transition-Metal Nanoparticles in Hollow Zeolite Single Crystals as Bifunctional and Size-Selective Hydrogenation Catalysts*, S. Li, A. Tuel, D. Laprune, F. Meunier, and D. Farrusseng, Chem. Mater., 2015, 27 (1), pp 276–282 -DOI: 10.1021/cm503921f

EXPLOITATION/LICENSING

- **Collaboration type sought:** Transfer of knowhow. Joint development for catalytic applications with industrial partners
- **Support provided:** Samples (1-10g) can be prepared and sent on request

CONTACT DETAILS

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