

Use of dendrimers in homogeneous and heterogeneous catalysis

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One of the main ideas of my research is the development of an unique hybrid catalyst that could perform various catalytic homogeneous, heterogeneous and “enzymatic” reactions. In this spirit, macromolecules such as dendrimers, have been underestimated in catalysis, especially as stabilizers of Metallic Nanoparticles (MNPs) for catalysis. The stabilization of PdNPs by a 9-triazol-27-triethylen glycol termini dendrimer allows the synthesis of a very active Pd catalyst for various homogeneous reactions such as C-C cross coupling reactions or hydrogenation reactions.¹ As example only 0.3 ppm of Pd were needed in the Suzuki-Miyaura cross coupling with bromoaromatics. ² The instability of the NPs under KOH/O₂ atm conditions forced us to support it on silica/iron oxide (shell/core) material. This new heterogeneous catalyst present similar activities than the homogeneous one, but the support brings magnetic recyclability and especially robustness allowing the alcohol oxidation under basic and O₂ conditions. ³ By a similar approach, Pd, Ru, Pt NPs have been synthesized in the presence of the commercial PAMAM dendrimer and then supported on mesoporous SBA-15 silica. These NPs have been used for the hydrogenation of methylcyclopentane in a gas flow reactor. As expected the ³ catalysts present different selectivity and excellent activity for this reaction overcoming the barriers of the supposed instability of dendrimer at high temperature (1st time that dendrimer is used under harsh conditions, and in a flow reactor). ⁴ Such catalysts could be used in other various homogeneous or heterogeneous reactions

as proved before in the group of Prof. Gabor Somorjai. ⁵ and have been used very recently in the hydrogen storage/release field. These catalysts present very high activity toward the acceptorless dehydrogenation of N-heterocyclic molecules (indoline and tetrahydroquinoline derivatives) i.e. hydrogen release and toward the revers reaction of N-heterocyclic aromatic molecules hydrogenation i.e. hydrogen storage. ⁶ Moreover, by playing on the oxidation state of the MNPs, the catalysis is able to perform either homogeneous catalysis or heterogeneous one.

Biography: Christophe V. Deraedt received his master's degree in nanoscience, life science, and chemistry in 2011 at the University of Bordeaux. He worked on the synthesis and uses of green nanoreactors (dendrimers and polymers) for catalysis of reactions including C-C bond formation and transformation, CuAAC “click” reactions, and hydrogenation chemistry for his Ph.D. with Prof. Didier Astruc. In 2016, he started a post doctorate in the group of Prof. Gabor A. Somorjai on the heterogenization of homogeneous catalysts. His main work involved synthesis and use of metallic nanoparticles stabilized by dendrimers and supported on silica for C-C, C-H bond activation, and dehydrogenation reactions. After one year as a temporary researcher/teacher (ATER) at the University of Bordeaux in the group of Prof. Frederic Castet, in January 2019 he joined the group of Jean-Pierre Djukic at the University of Strasbourg as a CNRS researcher. His work is now focused on the C-H and Si-H activation.

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