Materials for catalysis: challenges and opportunities

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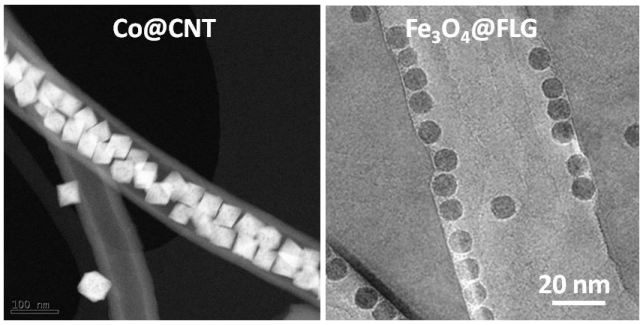
New catalytic materials have been extensively developed since the last decades for application in several research fields including sensors, drug delivery, light-weight high mechanical strength composites and catalysis. In this presentation, we will discuss about last developments on the use of (i) confinement effect in 1D carbon channel, (ii) nanostructuration of 2D carbon via catalytic patterning along with the uncovering of the patterning mechanism by operand transmission electron microscopy, and (iii) development of new bio-sourced mesoporous carbon doped with nitrogen as an active and selective metal-free catalyst for oxidation process. The first example reports on the use of confinement effect to modify and selectively cast, metal oxides, inside 1D carbon material for applications in the field of drug delivery, biological imaging and catalysis. In the second example, catalysis has been used to perform nanopatterning of few-layer graphene, leading to the generation of higher reactive edge sites, for the subsequence anchorage of metal oxide nanoparticles with improved sintering resistance for application in the field of sensor and liquid-phase reactions. The direct analysis of the process by *operando* TEM at ambient conditions allows one to uncover the different mechanisms operated during the patterning process for future optimization step. The last example focus on the synthesis of nitrogen-doped mesoporous carbon, issued from bio-sourced raw materials, decorated silicon carbide as metal-free catalyst for the selective oxidation of trace amount of H_2S into elemental sulfur with improved activity and stability. The presentation will end-up with some future perspectives about the use of carbon-based metal-free catalysts in some relevant catalytic processes as well as the role of *operando* TEM investigation for unraveling catalytic mechanisms.



Resume Cuong Pham-Huu

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Cuong Pham-Huu (1962) studied chemistry at the University Louis Pasteur (Strasbourg). He obtained his Ph.D. in the group of Dr. Marc-Jacques Ledoux (catalytic processes and materials) in 1991. He continued working in the field of heterogeneous catalysis during his postdoctoral at the Pechiney Research Center (Voreppe, France). From 1992 he joined the CNRS at the Laboratory of Chemistry and Materials for Catalysis as a scientific staff. At present, he is a scientific member of the Institute of Chemistry and Processes for Energy, Environment and Health (ICPEES). Currently, he is Research Director at the CNRS and head of the ICPEES (2012-2018). His research field is focus in the synthesis of 1D and 2D carbon-based materials and silicon carbide along with hierarchical composites for use in the fields of energy and environment. Target applications for these materials include innovative selective oxidation, dehydrogenation and hydrogenation reactions, synthetic fuel synthesis, fine chemical manufacture, environmental protection and sustainable energy production and storage (supercapacitors (electrochemical storage), CO_2 hydrogenation (chemical storage)). He (co-)authored over 230 peer-reviewed scientific publications and about 50 patents (https://scholar.google.fr/citations?user=t-7F8s4AAAAJ&hl=fr).