

第443回触媒科学研究所コロキウム

Bridging the gap between well-defined and industrial catalysts via a molecular approach

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Industrial processes, in particular large-scale ones, mostly rely on heterogeneous catalysts. The search for more sustainable processes and the changes in environmental policies impose the continuous development of improved catalyst performances and catalytic processes, as well as the exploration of alternative routes including renewable feedstocks. However, due to their inherent complexity, heterogeneous catalysts are mostly developed empirically rather than through detailed structure – activity relationships as the nature of the active sites are rarely known.

In this context, our group has been interested in understanding and controlling chemistry on surfaces, with the ultimate goal to generate isolated metal sites with defined chemical environment. This approach has been used to develop highly active and selective single-site catalysts that can overperformed their homogeneous counterparts, but it can also provide useful information to understand and further develop industrial catalysts or to study much more complex systems such as supported nanoparticles, where support effects, interfaces, alloying... remain complex to understand at the molecular level.

This lecture will be developed around these themes and will show how a careful characterization of surface sites on a molecular level (based on model systems and industrial catalysts) is key to develop high performance catalysts and to bridge the gap between fundamental and industrial catalysis. In particular, through surface organometallic chemistry principle and advanced spectroscopy, we will reveal the possible structure of active sites for a series of well-known and key industrial catalysts.

Prof. Christophe Copéret (CCH) was trained in chemistry and chemical engineering at CPE Lyon, France, and carried out a PhD in chemistry with Prof. E. Negishi (Purdue University, USA – 1991–1996), where he investigated the synthesis of complex molecules via Pd-catalyzed carbonylation reactions. After a postdoctoral stay with Prof. K.B. Sharpless (Scripps), CCH was offered a research position at CNRS in 1998 and was promoted CNRS Research Director in 2008. Since 2010, CCH is Professor in the Department of Chemistry and Applied Biosciences, ETH Zürich. His scientific interest lies at the frontiers of molecular, material and surface chemistry as well as NMR spectroscopy with the aims to design molecularly-defined solid catalysts through detailed mechanistic studies and structure–activity relationships. CCH is the President of the Platform Chemistry of the Swiss Academy of Sciences (SCNat), a member of boards (Swiss Chemical Society and EuChemS) and advisory boards of numerous journals (Catal. Lett., Catal. Sci. & Eng., Chem. Sci., Helvetica, Topics Catal...). CCH is also Associate Editor for the Journal of the American Chemical Society. Besides his scientific activities, CCH enjoys literature, history, cooking and wine tasting, probably a reminiscence of his childhood spent in the vineyards in Fleurie (La Reine), one of the famous crûs of Beaujolais, just ca. 50 km North of Lyon.

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