THE STABILITY OF SUPPORTED TRANSITION METAL CATALYSTS FOR SYNTHESIS GAS CONVERSION

P.E. de Jongh

Inorganic Chemistry and Catalysis, Debye Institute for Nanomaterials Science, Utrecht University
Universiteitsweg 99, 3584 CG Utrecht, The Netherlands

e-mail: P.E.deJongh@uu.nl

The transition from a fossil-fuels based to a renewable energy-based society poses large challenges. This is related to fundamental differences in the physico-chemical nature of these energy sources. Coal, oil and gas are (or are easily interconverted into) solid, liquid and gaseous fuels. In contrast the most prominent renewable energy sources (solar and to a lesser extent wind energy) generate electricity, an energy vector for which storage is not self-evident. Hence to fully switch to renewables, efficient and cost-effective energy storage is indispensible, and it is difficult to imagine not at least partially relying on chemical fuels. One possibility is to generate sustainable hydrogen by electrolysis (using solar/wind electricity) and combining with CO_2 to form synthesis gas, which can be converted in a range of chemical including liquid fuels, methanol, and synthetic gas.

These reactions are steered by transition metal catalysts, typically supported metal nanoparticles (<10 nm). However metal nanoparticles have an inherent tendency to grow into larger crystallites at increased temperatures and in reactive gas atmosphere, leading to a decrease in the specific metal surface area and hence activity. Generally the catalyst stability is lower when higher CO_2 concentrations are involved. However, relatively little is still known about the mechanisms of particle growth. In detail I will discuss the catalyst stability during the conversion of H_2 and CO/CO_2 into methanol under realistic catalytic conditions. We vary particle parameters and support parameters using 3D model catalysts. Our aim is to understand in detail the interplay of different structural parameters and to obtain information on the nature of the mechanism of particle growth (for instance Ostwald ripening versus particle migration and sintering), in order to design more robust catalysts for synthesis gas conversion.

References:

Nature Mater. 12, 23 (2013); 2 ACS Nano 8, 2522 (2014); 3 J. Am. Chem. Soc. 137, 7333 (2014); Angew. Chem. Int. Edit 126, 9647 (2014); Angew. Chem. Int. Edit. 54, 11804 (2015).

Picture of Author	Short Biography of Author
	Petra de Jongh received her PhD in photoelectrochemistry in 1999, and worked 5 years as a senior scientist at Philips Research. Since 2004 she works at Utrecht University, where she is now chair of Inorganic Nanomaterials. She is specifically interested in nanoporous materials and supported nanoparticles for applications in catalysis and energy storage and conversion.