

Title: About active sites and spectators in heterogeneous catalysis

Abstract:

The focus of my talk will address the difficulty to measure the structure of catalytically active sites in heterogeneous catalysis. Most catalysts have large structural heterogeneity and the identification of what constitutes the active site is very complex. In supported metal catalysts, the support cannot be assumed to be an inactive component. Ceria is a well-known support that is able to store and release oxygen. For that reason, it finds application in reactions that involve redox reactions. Upon oxygen release, part of CeIV reduces to CeIII. The ceria oxygen-storage capacity and the presence of CeIII are often related to catalytic performance, however quantitative descriptions are lacking. By building on recently developed spectroscopic tools based on x-ray absorption and emission spectroscopy on the one hand and electron spectroscopy on the other, we have been able to quantify the role of CeIII in the oxidation of carbon monoxide over Pt/CeO₂. Transient measurements with high time resolved x-ray emission spectroscopy showed the existence of CeIII as spectator and as active intermediate in the reaction. The consequences of these observations on the relationship between oxygen storage capacity and the presence of CeIII on catalytic performance will be discussed.

Bio:

Jeroen A. van Bokhoven completed a degree in chemistry at Utrecht University (Netherlands) in 1995 and went on to obtain a PhD in inorganic chemistry and catalysis from the same university in 2000 (with honours). From 1999 until 2002 he was head of the XAS (X-ray absorption spectroscopy) users - support group at Utrecht University. In 2002, he moved to the ETH, where he worked as senior researcher in the group of professor Prins. In 2006 he obtained an SNF assistant professorship in the Department of Chemistry and Applied Biology. He was the 2008 recipient of the Swiss Chemical Society Werner Prize.

Since 2010, Jeroen A. van Bokhoven has a Chair in Heterogeneous Catalysis at the Institute for Chemical and Bioengineering at ETH Zurich and is Head of Laboratory for Catalysis and Sustainable Chemistry at Paul Scherrer Institute.

Van Bokhoven works in the field of heterogeneous catalysis and (X-ray) spectroscopy. Goal is the determination of structure-performance relationships, which aid the design and construction of better catalysts for cleaner and more efficient processes. His main interests are heterogeneous catalysts and developing advanced tools in X-ray spectroscopy to study the catalyst structure under catalytic relevant conditions.