

The utilization of the isotopic exchange technique in redox heterogeneous catalysis

by

Nicolas BION, CNRS permanent Researcher

Institut de Chimie des Milieux et Matériaux de Poitiers (IC2MP) – University of Poitiers / CNRS

4 rue Michel Brunet 86073 Poitiers Cedex 9 (FRANCE), nicolas.bion@univ-poitiers.fr

The phenomena of surface active species mobility are crucial in catalysis : it may correspond to one step of the catalytic mechanism or may influence the steps of activation and regeneration of the catalyts. Therefore species migration play a key role in numerous processes like the reforming reaction, the 3-way catalysis as well as reactions involving a spillover of active species.

The Laboratoire de Catalyse en Chimie Organique (LACCO), recently re-organized in the Institut de Chimie des Milieux et Matériaux de Poitiers (IC2MP) developed the isotopic exchange technique, a powerful technique to study the reaction between gas phase (oxygen or hydrogen) and metal oxide or oxide catalyts[1]. In such studies, two general reaction types have been investigated: (i) homomolecular exchange in which a mixture of labeled molecules is scrambled over a surface, and (ii) heterolytic exchange in which a labeled molecule is scrambled with the “lattice” atom of the catalyts isotopes). From the curves which register the partial pressures of the different isotopomers of the exchanged molecules, information on the exchange mechanism and on surface and bulk diffusion coefficient of active species can be obtained. Coupling this technique with spectroscopic characterization techniques such as FTIR or NMR gives complementary data on the nature of the active species or the active sites in the exchange process.

In the seminary, earlier studies dealing with the oxygen mobility in ceria-based 3-way catalyts will be presented. Some more recent works carried out in oxidation catalysis (CO PrOx, CH₄ combustion, partial oxidation of CH₄) will be also exposed.

[1] D. Duprez, *Isotopes in Heterogeneous Catalysis*, Catalytic Science Series Vol. 4, Imperial College Press, London, 2006, 133 –181.