First International School on Applied Catalysis and IX Italian Seminar on Catalysis 2007

"Characterization of catalysts: a key step in the development and utilisation of innovative catalytic systems"

June 3-9, 2007
Hotel Residence
Riva del Sole
SS 16 km 787
Giovinazzo - Bari

Book of Abstracts

P15

Preparation on nanostructured TiO_2 supported platinum catalysts by photochemical deposition

Bruno F Machado[1], Helder T Gomes[1,2], Joaquim L Faria[1]
[1]Laboratório de Catálise e Materiais, Departamento de Engenharia Química, Faculdade de Engenharia da Universidade do Porto, Portugal
[2]Departamento de Tecnologia Química e Biológica, Escola Superior de Tecnologia e de Gestão, Instituto Politécnico de Bragança, Portugal
bmachado@fe.up.pt

Nowadays, thanks to a growing environmental awareness, selectivity is seen as the major driving force in catalyst research and development. In order to design the best possible catalyst there are several parameters that can be fine tuned depending on the type of reaction. Type of metal, support or thermal surface treatments are variables known to influence selectivity, as in the hydrogenation of organic substrates containing unsaturated functional groups. Selectivity towards the normally unfavoured hydrogenation of the carbonyl group instead of the C=C olefinic bond can be improved in presence of metal particles with sizes above 3 nm[1]. To a certain extent the metal deposition step allows particle size control, and innovative techniques, some more simple other more complex, are currently being developed. In this field, photochemical deposition of noble metals in different supports is gaining importance due to its simplicity and advantages. The main advantage is the ability of spreading very effectively the metal throughout the support, leading to high metal dispersions with particle size in the desired range. Additionally, if the support is a semiconductor, like TiO_2, the deposited metal ions are also automatically reduced mainly through the action of conduction band electrons.

Titanium dioxide supported platinum catalysts (1 and 3 wt.%) were prepared by liquid phase photodeposition of $H_2PtCl_6{\cdot}6H_2O$ precursor. Thermal treatments under N_2 and H_2 were performed at 773K (1Pt/TiO_2-773 and 3Pt/TiO_2-773) providing materials with variable particle sizes at the nanometer scale. The prepared catalysts were tested on the liquid phase selective hydrogenation of cinnamaldehyde to cinnamyl alcohol (100mL stainless steel autoclave at 363K and 10bar). The preferred unsaturated alcohol is obtained by the reduction of the carbonyl group as opposed to hydrogenation of C=C olefinic bond to yield the saturated aldehyde. Allylic alcohols are valuable intermediates in the production of fragrances, flavoring additives, pharmaceuticals and agrochemicals.

Under laboratory conditions thermally treated 3Pt/TiO_2-773 catalyst revealed a selectivity towards cinnamyl alcohol of 55% at 87% conversion, against 28% selectivity at 27% conversion under similar conditions for the untreated catalyst. These results were explained by a combined effect of SMSI and platinum particle size increase. The catalysts were also tested in oxo-steroid selective hydrogenation and extremely promising results were obtained.

Acknowledgements: BFM acknowledges FCT the PhD grant SFRH/BD/16565/2004.Work supported by FCT and FEDER (POCI/EQU/58252/2004 and POCTI/1181/2003).

[1] Gallezot, P and Richard, D *Catalysis Reviews-Science and Engineering*, **1998**, *40*, 81-126.