

**Furfural hydrogenation on P-promoted Ru/Al<sub>2</sub>O<sub>3</sub>**T. Fovanna<sup>1,3</sup>, A. Villa<sup>2</sup>, M. Nachtegaal<sup>1</sup>, O. Kröcher<sup>1,3</sup>, D. Ferri<sup>1\*</sup><sup>1</sup>Paul Scherrer Institute, Villigen, <sup>2</sup>University of Milano, <sup>3</sup>EPF Lausanne

Hydrogenation of furfural has gained increasing attention as it represents one of the platform chemicals with a large pool of useful chemical products such as furfuryl alcohol [1]. Investigation of phosphorus as a promoter for Ru nanoparticles (NP) supported on Al<sub>2</sub>O<sub>3</sub> for the selective hydrogenation of furfural to furfuryl alcohol in isopropanol has been the focus of this work. For this purpose, two Ru/Al<sub>2</sub>O<sub>3</sub> catalysts were prepared by impregnation of  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> with Ru(NO)(NO<sub>3</sub>)<sub>3</sub>. The resulting Ru<sub>salt</sub>/Al<sub>2</sub>O<sub>3</sub> was split in two batches. The first batch was processed by reduction at 500°C, while the second batch was further impregnated with NH<sub>4</sub>H<sub>2</sub>PO<sub>2</sub> followed by reduction at 500°C. The catalysts were characterized by XRD, STEM, NMR, CO and pyridine adsorption and XAS at the Ru k-edge. The sample treated with P exhibited a homogeneous dispersion of small Ru NP. Beside the difference in Ru particle size between the two samples, the catalysts exhibited different acidic properties. RuP/Al<sub>2</sub>O<sub>3</sub> displayed predominantly Brønsted acidity, which may also contribute to the better conversion rate and selectivity towards furfuryl alcohol compared to the Ru/Al<sub>2</sub>O<sub>3</sub> homologue. Finally, catalytic activity was also compared to that of commercial Ru/C in batch reactor at 180°C and 5 bar of H<sub>2</sub>. Phosphorus also improved the stability of the catalyst; leaching tests indicated a loss of 4% Ru in RuP/Al<sub>2</sub>O<sub>3</sub> that did not change further after the first cycle, whereas Ru/C showed an initial loss of 7%. Despite the difficulty to discriminate the contribution of Brønsted acidity and smaller and well dispersed Ru NP, phosphorus appears to be a promising catalyst promoter for the selective hydrogenation of furfural to furfuryl alcohol.

[1] Andrea B. Merlo, Virginia Vetere, José F. Ruggera, Mónica L. Casella, *Catalysis Communications*, **2009**, *10*, 1665-1669.