

# Effect of chlorine-containing VOCs on silver migration and sintering in ZSM-5 used in a TSA process

Arnaud Monpezat <sup>1</sup>, Gabriel Couchaux <sup>1</sup>, Vincent Thomas <sup>1</sup>, Antoine Artheix <sup>1</sup>, Ludovic Deliere <sup>1</sup>, Claire Gréau <sup>1</sup>, Sylvain Topin <sup>1,\*</sup>, Benoit Coasne <sup>2</sup>, Lucian Roiban <sup>3</sup>, Luis Cardenas <sup>4</sup> and David Farrusseng <sup>4,\*</sup>

<sup>1</sup> CEA, DAM, DIF, F-91297 Arpajon – Cedex, France

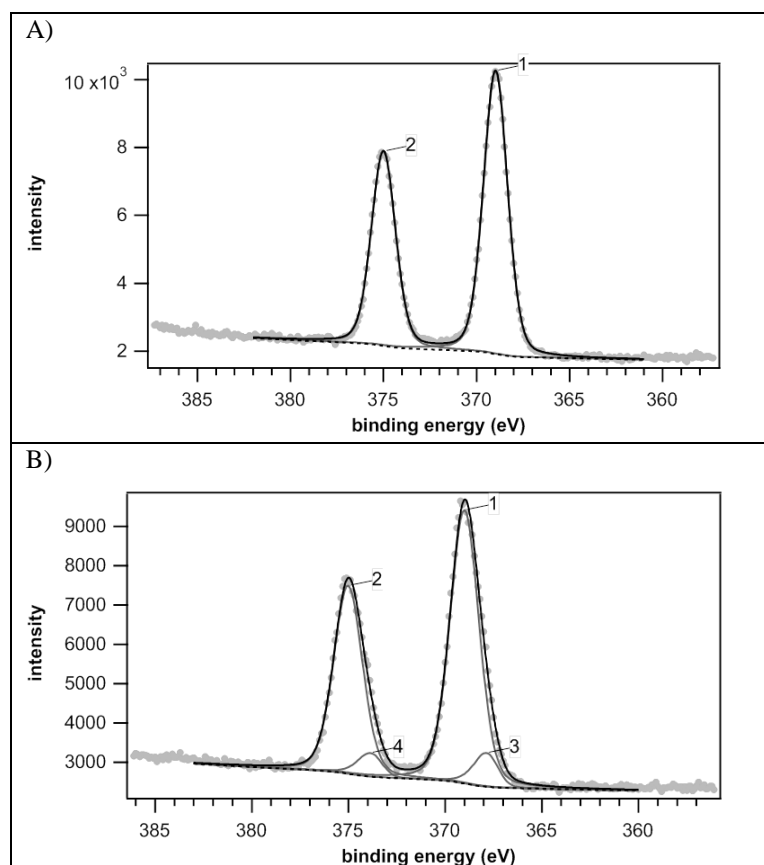
<sup>2</sup> LIPhy, Université Grenoble Alpes, UMR 5588 CNRS, 140 rue de la physique, 38058 Grenoble Cedex 9, France

<sup>3</sup> Univ. Lyon, INSA-Lyon, Université Claude Bernard Lyon I, MATEIS, UMR5510 CNRS, 7 Avenue Jean Capelle, F-69621 Villeurbanne Cedex, France

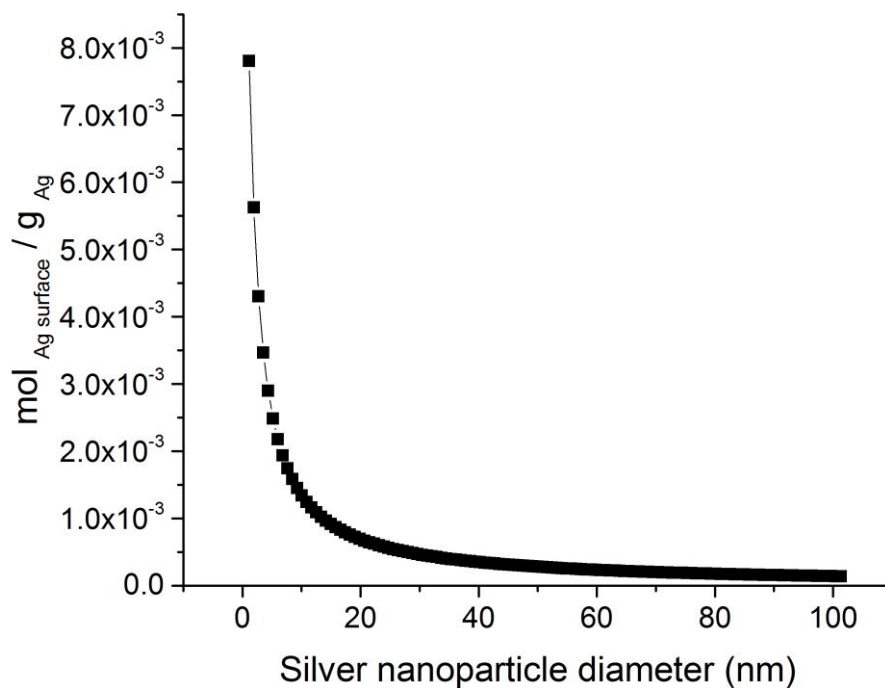
<sup>4</sup> Univ. Lyon, IRCELYON, Université Claude Bernard Lyon I, UMR 5256 CNRS, 2 Avenue Albert Einstein, F-69626 Villeurbanne Cedex, France

\* Correspondence: david.farrusseng@ircelyon.univ-lyon1.fr; sylvain.topin@cea.fr

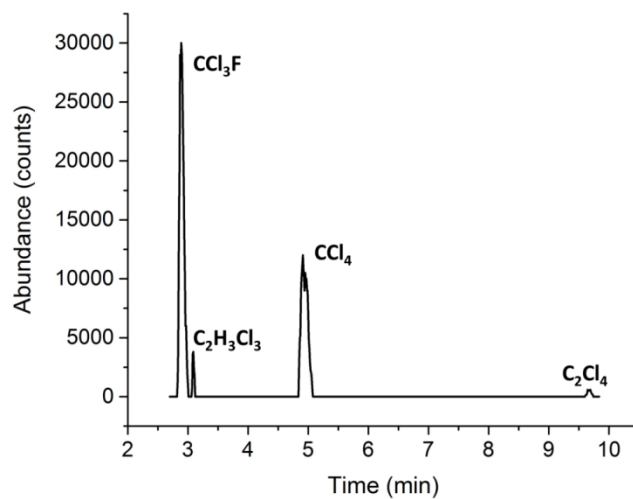
**Keywords:** Zeolite, silver nanoparticles, sintering, poisoning, adsorption



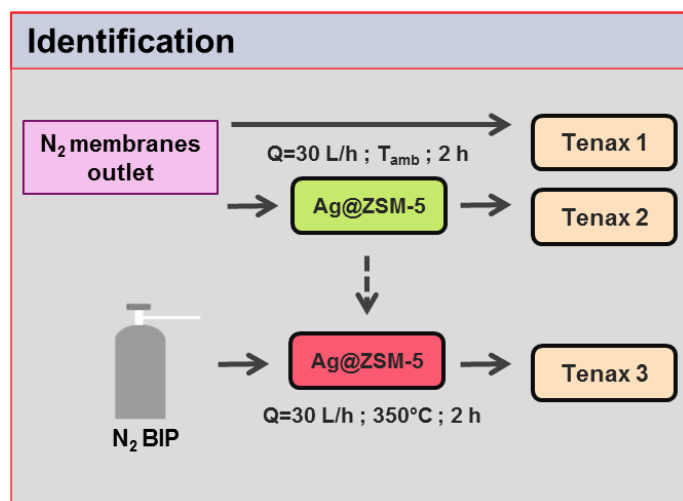
**Figure S1.** X-ray photoelectron (XPS) measurement results recorded for the fresh (A) and degraded (B) Ag@ZSM-5 samples. While the peak 1 and 2 correspond to silver, peak 3 and 4 are characteristic of an AgCl phase.



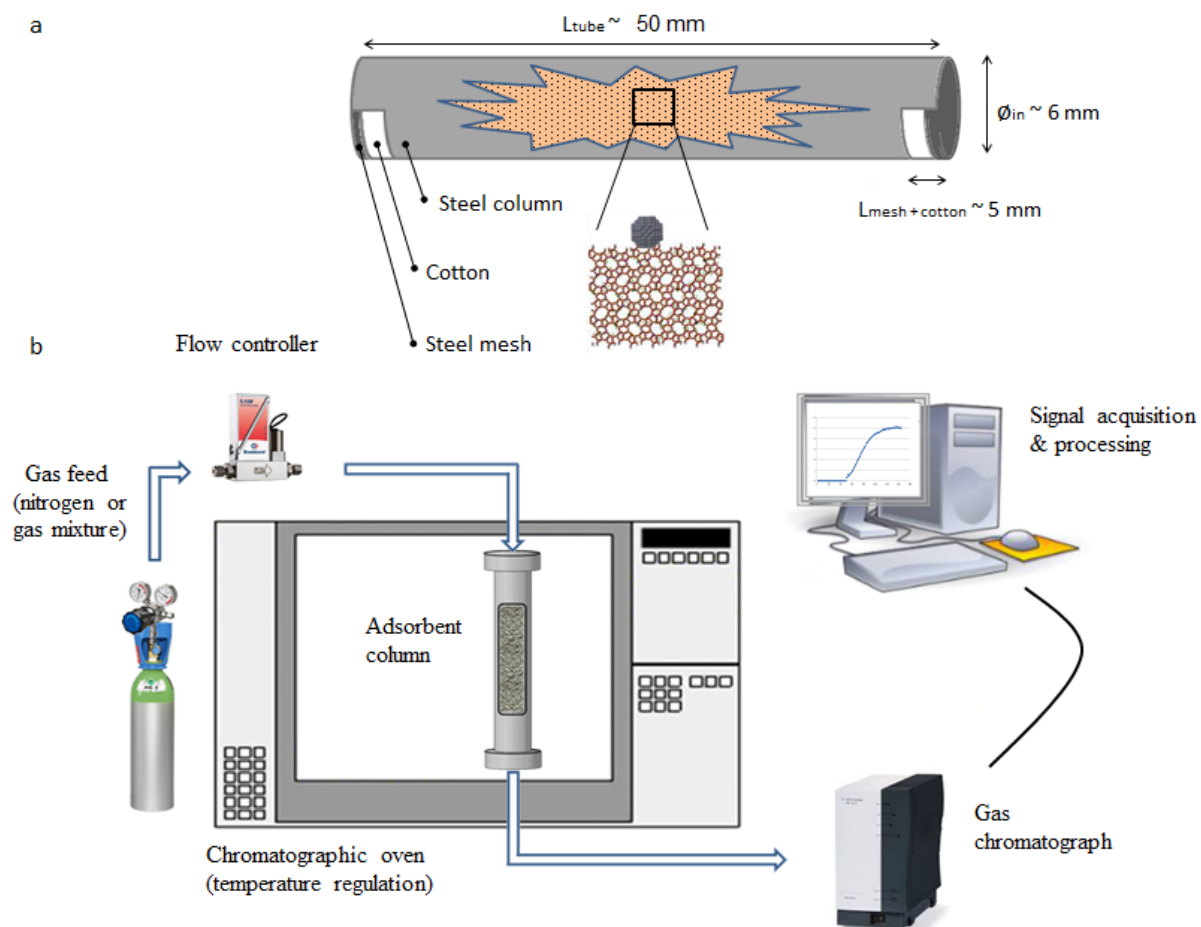
**Figure S2.** Amount of silver (mol) at the surface of the nanoparticles per gram of silver and according to the particle size.



**Figure S3.** Analysis at the membrane gas outlet of the organic chlorinated compounds. Gas analysis screening consisting in the adsorption of compounds for 2 hours onto Tenax tube followed by thermodesorption and gas chromatography coupled to mass spectrometry.



**Figure S4.** Schematic representation of the Tenax tubes preparation for the identification of Cl-COV in the process gas.



**Figure S5.** Schematic representation of the breakthrough experiments on adsorptive materials. (a) The column (50 mm long x 6 mm inner diameter) used for the breakthrough experiments is filled with the adsorbent (Ag@ZSM-5) and plugged with cotton and a steel mesh at each end. The steel tube is shown in grey while the steel mesh is in darker grey, the cotton in white and the adsorbent in orange speckled. (b) The experimental set-up is composed of the adsorption column as the central element positioned in a chromatographic oven used to precisely control the temperature during the breakthrough experiments. The gas is injected at a given pressure (air liquid valve) and flow (Bronkhorst controller El Flow: 80 mL/min) in the column by the head and exits at the bottom. The flow is then sent towards the gas chromatograph (VARIAN, 490-GC). This device is connected to a computer for signal acquisition and processing.