

Example Abstract for the UK Catalysis Conference (replace with your title)

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Introduction

The formatting of this document should be observed for your submission. Body text is 8pt Times New Roman; the title is 10pt Times New Roman. Please keep margins and columns as is. The document margins are 1" (2.54 cm) top, bottom, left and right. The entire document must fit on a single A4 page, in two columns as defined in this document.

Standard sections are Introduction, Materials and Methods, Results and Discussion, Significance and References.

Color figures are permitted for submission. The below text shows examples of acceptable formatting and citations for tables, figures and references.

Materials and Methods

A 2 wt% Ag/Al₂O₃ catalyst was prepared by the impregnation of γ -Al₂O₃ support with a silver nitrate solution followed by drying and calcination at 550°C. Catalytic activity tests were performed at 250 °C and ambient temperatures with 720 ppm NO, 620 ppm toluene or 542 ppm C₈H₁₈, 7.2% CO₂, 7.2% H₂O, 5% O₂, and with the balance He. The experiments were designed to obtain information on the activity of the SCR catalyst when the atmospheric pressure helium-NTP was in direct contact with the catalyst bed. Two different electrode configurations were used to generate the plasma. For the catalytic activity tests, the dielectric barrier discharge was generated between two external circular copper electrodes and the 2% Ag/Al₂O₃ catalyst sample was placed in the centre of a fixed-bed flow system with T-shape quartz tube reactor. The DRIFTS-MS measurements were carried out at ambient temperature *in situ* in a high temperature cell fitted with ZnSe windows. A quartz covered tungsten wire with a pencil-shaped tapered end was inserted into a quartz tube to act as a powered electrode. The capillary tube, with a 50 cm³ min⁻¹ helium flow, was one arm of a T-shape quartz tube. A high voltage probe (Tektronix, P6015) and a calibrated Rogowski coil (Pearson) connected to a digital oscilloscope (LeCroy WavePro 7300A) were used to measure the variable, time-dependent applied voltage and current. The powered electrode was driven at peak voltages from 6 to 7 kV and modulated from 16 to 23 kHz.

Results and Discussion

When the plasma was combined with an Ag/Al₂O₃ catalyst a strong enhancement in activity was observed when compared with conventional thermal activation with high conversions of both NO_x and hydrocarbons obtained at temperature ≤ 250 °C, where the silver catalyst is normally inactive. As shown in Figure 1, the conversion of NO_x with octane and toluene was significantly improved at 250 °C and was found to be 25 and 74%, respectively, when the NTP was on. Furthermore, the conversion of both octane and toluene was almost complete (> 99%) in the presence of NTP. A remarkable SCR activity of the Ag-catalyst was also observed in the absence of an external heat source with NTP.¹ NO_x conversions of ~52% in the case of *n*-octane and ~42% in the case of toluene were obtained, with hydrocarbon conversions of ~99% and ~89%, respectively.

Figure 2 shows the substantial differences of *in situ* DRIFTS spectra of surface species adsorbed on the Ag/Al₂O₃ catalyst during the octane-SCR reaction with plasma at

ambient temperature. It is evident that switching on NTP has resulted in changes in the intensity of surface species in which adsorbed octane was decreased together with the formation of other adsorbed species such as nitrates, acetates, carboxylates and so on. It is interesting to note that similar species such as isocyanates (2260 cm⁻¹) and cyanides (2165 cm⁻¹) were observed to those seen when H₂ was used to promote the HC-SCR reaction, as reported by Chansai et al.² This indicates that the plasma could help to activate both NO and hydrocarbon.

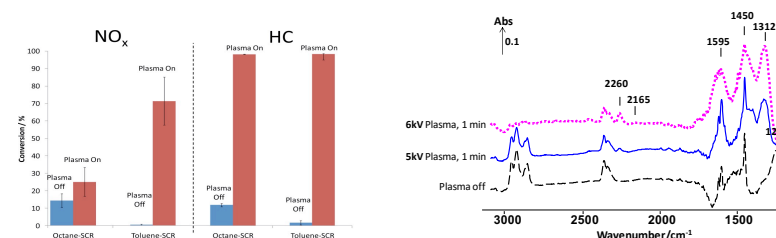


Figure 1. NO_x and hydrocarbon conversions during the HC-SCR of NO_x reaction over 2 wt% Ag/Al₂O₃. Feed composition: 720 ppm NO, 4340 ppm (as C1) HC, 4.3% O₂, 7.2% CO₂, 7.2% H₂O and He balance. The total flow rate and space velocity was 276 cm³ min⁻¹ and 165600 cm³ g⁻¹ h⁻¹, respectively.

Figure 2. Changes in surface species observe during the octane-SCR of NO_x reaction on Ag/Al₂O₃ with and without plasma. Feed composition: 720 ppm NO, 4340 ppm (as C1) C₈H₁₈, 5% O₂, 4% H₂O and He balance. The total flow rate was 100 cm³ min⁻¹.

Table 1. NTP product selectivities and NO_x and hydrocarbon conversion (HC) at room temperature.

	%NO _x conv.	%N ₂ select.	%N ₂ O select.	%HC conv.	%CO ₂ select.	%CO select.
Octane-SCR	51.7	77.9	21.5	98.8	86.1	13.5
Toluene-SCR	42.4	96.1	1.5	89.1	90.0	10.0

Significance

An atmospheric pressure non-thermal plasma system was developed to assist the low temperature SCR activity of an Ag/Al₂O₃ catalyst with octane and toluene. It has been shown that NO_x reduction is remarkably enhanced at very low temperatures. The *in situ* DRIFTS measurement indicated that the NTP could help to activate both NO and hydrocarbon, proving a real insight into the mechanism by which plasma can promote this reaction at 25 °C. This low temperature activity provides the basis for increased exhaust gas treatment during cold start conditions which remains an important issue for mobile and stationary applications.

References

1. Stere, C. E.; Adress, W.; Burch, R.; Chansai, S.; Goguet, A.; Graham, W.G.; De Rosa, F.; Palma, V.; Hardacre, C. *ACS Catalysis* **2014**, *4*, 666.
2. Chansai, S.; Burch, R.; Hardacre, C.; Breen, J.; Meunier, F. *J. Catal.* **2011**, *281*, 98.