Probing a Non-Thermal Plasma Activated Heterogeneously Catalysed Reaction Using *in Situ* DRIFTS-MS

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Figure S1 shows typical current-voltage sinusoidal waveforms when the discharge was present. There is a clear phase difference of about 90° between the current and voltage, the same as when the discharge was turned off.
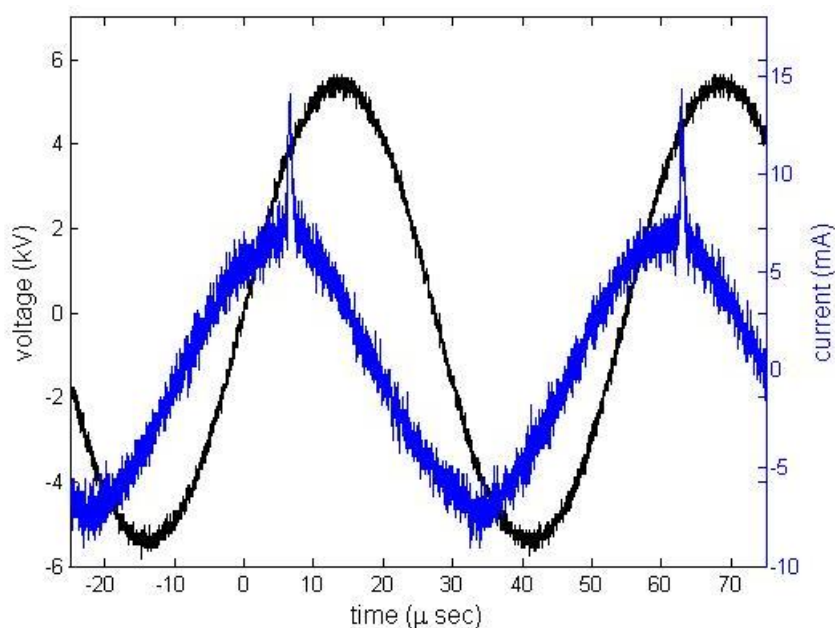

Figure S1: Typical one cycle current and voltage sinusoidal waveforms at 6 kV applied voltage, 18.5 kHz and a 2000 cm^3 min^{-1} gas flow.

The instantaneous input power P_{in} and the power dissipated during the discharge process P_{dis} are given by the following expressions [1]:

$$P_{in} = V_a(t)\, I_{DBD}(t) \tag{1}$$

$$P_{dis} = V_{gap}(t)\, I_{gap}(t) \tag{2}$$

The mean value of the input power and the consumed power are defined by the following integration over one wave cycle:

$$\langle P_{in} \rangle = \frac{1}{T}\int_0^T p_{in}(t)\,dt \tag{3}$$

$$\langle P_{dis} \rangle = \frac{1}{T}\int_0^T p_{dis}(t)\,dt \tag{4}$$

The mean value of the input power and the consumed power in the DBD plasma, under typical operational conditions (6kV, 20 kHz and 2000 cm^3 min^{-1} gas flow rate), were found to be 12 W, and 5W, respectively (with an actual plasma current between 5-5.5 mA).

Figure S2 shows the experimental data of the nitrogen emission line (377-381 nm) for the toluene-SCR reaction, which corresponds to a rotational gas temperature of 91°C at 6kV and 102°C at 7 kV applied voltage.
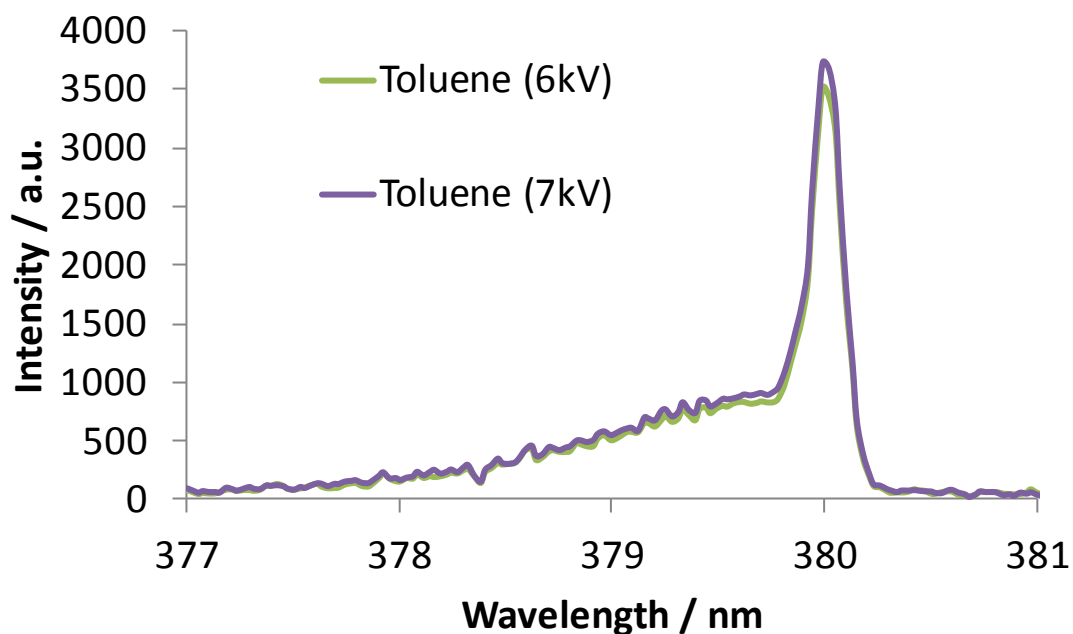

Figure S2: Experimental emission spectra of the second positive system of nitrogen for the toluene-SCR reaction at 6 and 7 kV applied voltage.
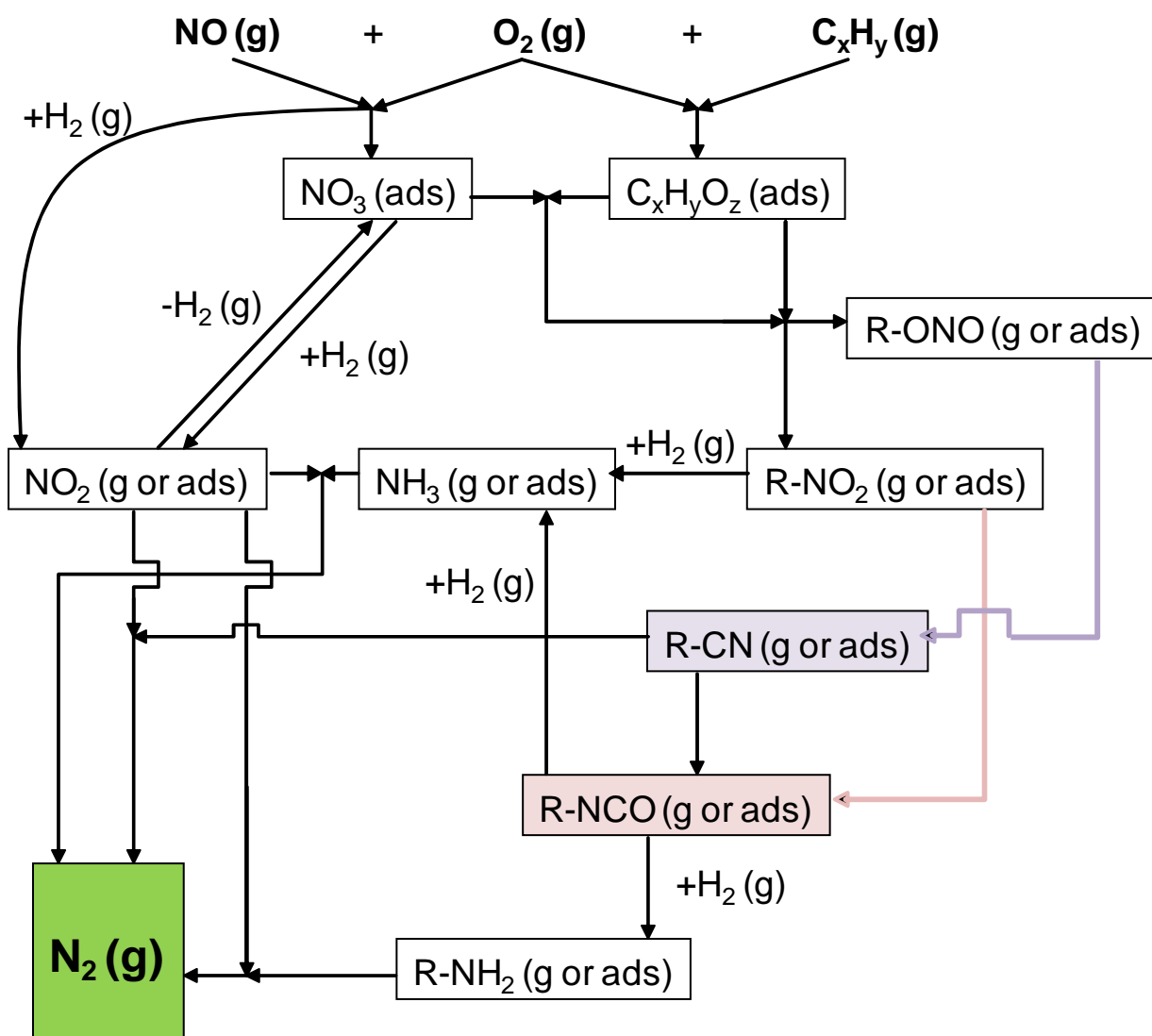
Figure S3: Reaction pathways for HC-SCR deNO$_x$ reaction over a silver-based catalyst (adapted from ref [2,3,4]).

References

[1]   Liu, S.; Neiger, M. *J. Phys. D: Appl. Phys*. **2003**, 36, 3144-3150.
[2]   Shibata, J.; Shimizu, K.;Satokawa, S.; Satsuma, A.; Hattori, T. *Phys. Chem. Chem. Phys.***2003,** 5, 2154-2160.
[3]   Breen, J.P.; Burch, R.; Hardacre, C.; Hill, C.J.; Rioche, C. *J. Catal.* **2007**, 246, 1-9.
[4]   Eränen,K.; Klingstedt, F.; Arve, K.; Lindfors, L.E.; Murzin, D.Y. *J. Catal.* **2004**, 227, 328-343.