

# Supporting Information: Electrical stability and performance of a Nitrogen-Oxygen atmospheric pressure gliding arc plasma

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# 1 FTIR Data Analysis

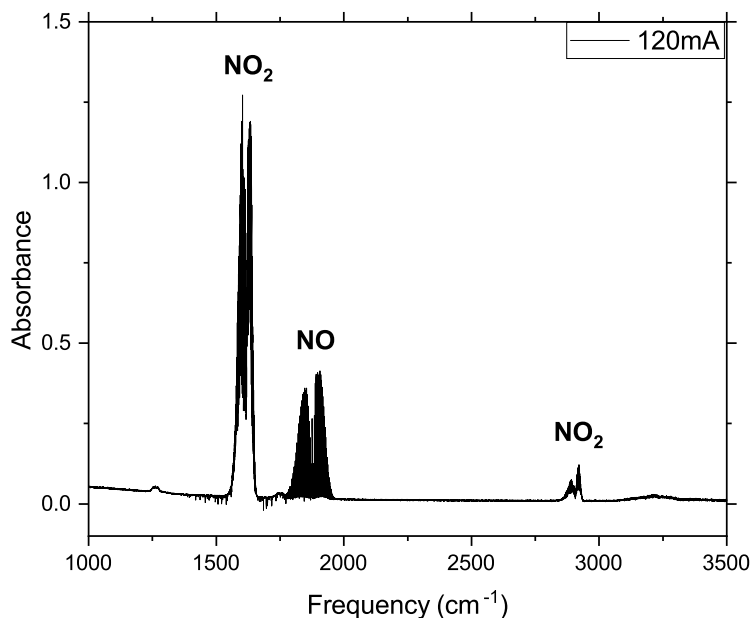


Figure 1: FTIR spectra acquired between 1000 and 3500  $\text{cm}^{-1}$  for  $\langle I \rangle$  equal to 120 mA. The absorption bands at 1876  $\text{cm}^{-1}$  and 2916  $\text{cm}^{-1}$  were used for NO and NO<sub>2</sub> respectively

The IR beam is attenuated after passing through the gas contained in the gas cell. The intensity of the attenuated beam can be described using the Beer-Lambert absorption law, assuming a homogeneous density distribution.<sup>1,2</sup> Finally, the absorbance, defined as the logarithm of the ratio of the initial and the detected beam intensities, is calculated.

Figure 1 shows an example of an absorption spectrum in this work. The only species observed by FTIR absorption spectroscopy are NO and NO<sub>2</sub>, measured through their transitions with main band heads at 1876  $\text{cm}^{-1}$  and at 2916  $\text{cm}^{-1}$ , respectively. The NO<sub>2</sub> band located at 1617  $\text{cm}^{-1}$  was not used due to its high absorbance. An absorbance above 1 corresponds to less than 10% of the incident photons with a specific wavelength reaching the detector. This is generally considered too low for the FTIR measurement to be consistent and for the linear dependency with the NO<sub>2</sub> concentration, described by the Beer-Lambert

law to be valid. The considered NO transition corresponds to the absorption due to the excitations from the ground state to the first vibrational level.<sup>3</sup> The mentioned NO<sub>2</sub> transitions are, as well, excitation to low vibrational assignments from the ground state.<sup>4</sup> Considering that there is no overlap between the spectra of the two species, their contribution to the total absorbance can be easily distinguished. The absorbance  $A(\nu)$  of NO and NO<sub>2</sub> in the presence of plasma can be integrated and compared with the calibrated spectra in order to deduce their absolute densities using Beer-Lambert's law.

$$\begin{aligned} \int A(\nu) &= \int \sum_j n_j \sigma_j(\nu) d\nu = \sum_j n_j \int \sigma_j(\nu) d\nu \\ &= n_{NO} \int \sigma_{NO}(\nu) d\nu + n_{NO_2} \int \sigma_{NO_2}(\nu) d\nu \end{aligned} \quad (1)$$

Where,  $n_j$  and  $\sigma_j(\nu)$  are the densities and the cross sections, respectively, for photon absorption as a function of the incident frequency of all the sampled species  $j$ . As NO and NO<sub>2</sub> are the only species probed by FTIR in the reactor, the equation is simplified in the last step. As a result of the fact that the integral of the cross sections is constant, the ratio between the absorbance of a plasma-generated gas mixture and the calibration gas set of measurements corresponds to their NO or NO<sub>2</sub> density ratio. In this work, part of the results is shown in terms of the NO<sub>x</sub> yield, combining NO and NO<sub>2</sub> together according to the following equation:

$$\text{NO}_x \text{ Yield} = \frac{(n_{NO} + n_{NO_2})}{n_0} 100\% \quad (2)$$

where  $n_0$  is the initial gas density. The statistical error associated with the absorbance value is determined by repeating measurements for the same experimental conditions and estimated to be of the order of 1% of the measured values.

## References

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