

## Dominant pathways in the conversion of CO<sub>2</sub> via radio-frequency atmospheric pressure plasmas

Alexander P. S. Foote<sup>1</sup>, James Dedrick<sup>1</sup>, Juri Raud<sup>1</sup>, Deborah O'Connell<sup>1</sup>, Michael North<sup>2</sup> and Timo Gans<sup>1</sup>

<sup>1</sup> York Plasma Institute, Department of Physics, University of York

<sup>2</sup> Green Chemistry Centre of Excellence, Department of Chemistry, University of York

\* Corresponding author: [af637@york.ac.uk](mailto:af637@york.ac.uk)

The generation of CO from CO<sub>2</sub> on demand could provide a much safer means of generating just the required amount of CO, and remove the need to store CO in pressurised cylinders<sup>1</sup>. The key challenges in using this method, for CO production, are optimising the energy efficiency, maximising the conversion of CO<sub>2</sub> into CO and then separating the CO from the other species produced in the plasma. Many reactions occur within a plasma and not all of these are desirable<sup>2</sup>. Understanding the reaction mechanisms in both the core and the effluent of the plasma will enable greater optimisation of the system to favour the desirable reactions and suppress the undesirable reactions.

To generate a plasma at atmospheric pressure the CO<sub>2</sub> is fed into a carrier gas, helium or argon, because a pure CO<sub>2</sub> plasma is more challenging to generate at atmospheric pressure by a radio-frequency discharge. A high yield of CO can be obtained using either helium or argon, 69.43% and 92.13% respectively, but at the expense of a low energy efficiency, 0.28% and 0.21% respectively.

A global model<sup>3</sup> has been used for comparison with the experiments. The yields of CO and the energy efficiency are in good agreement with the experiment. The global model can be used to make predictions about the density of the species not currently measured and the reaction pathways can be analysed to show the dominant processes in the plasma.

### References

- (1) Taylan, O.; Berberoglu, H.; *Plasma Sources Sci. Technol.* **2015**, *24*, 015006-015014.
- (2) Aerts, R.; Martens, T.; Bogaerts, A.; *J. Phys. Chem. C* **2012**, *116*, 23257-23273.
- (3) Dorai, R.; Kushner, M.; *J. Phys. D: Appl. Phys.* **2001**, *34*, 574-583.