# Gliding arc discharge for $CO_2$ conversion: An experimental study of different discharge configurations

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This experimental study examines the usage of low current ($10^2$ mA) gliding arc discharges (GAD) for $CO_2$ dissociation, at atmospheric pressure. Several types of discharges are tested and compared. These include the traditional diverging electrode setup, and modifications of that concept which employ the use of a constant external magnetic field to stabilize [1] or accelerate the arc.

The discharge device consists of two diverging electrodes, placed between quartz glass plates. The $CO_2$ gas is introduced from a nozzle, located at the closest distance between the electrodes. The quartz glasses channel the gas flow, so that most of the inlet gas passes through the arc. In the magnetically stabilized configuration, the magnetic field pushes the arc in a direction opposite to the gas flow and the arc is stabilized at a certain location along the electrodes and remains at a fixed length.

The two main quantities of interest are the percent of converted $CO_2$ gas, and the energy efficiency of the conversion process. The main input parameters are the gas flow rate and the discharge current.

The results presented in this work show how the values of the conversion and efficiency depend on the inlet flow rate and the input power. Generally, the conversion decreases with the flow rate and increases with power. The decrease in the conversion with the increase in the gas flow is more pronounced in the magnetically stabilized setup, when compared to the traditional gliding types. The efficiency increases with the flow rate, for all types of discharges. The measured values for the conversion and efficiency strongly depend on the profile of the flow, which influences the arc behaviour – its length (voltage drop), attachment, etc. The magnetically stabilized configuration is generally more stable and efficient, but has poor performance at high flow rates. The non-stabilized configurations show good conversion for a larger range of inlet flow rates, but are generally more unstable and less efficient.

[1] Ivanov V, Paunska Ts, Tarnev Kh and Kolev St 2021 *Plasma Sources Sci. Technol.* **30** 085007