Time-resolved optical emission spectroscopy in CO_2 nanosecond pulsed dicharges

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Contents

1 Abstract **3**

1 Abstract

Non-thermal discharges are seen as a promising way to achieve plasma(-catalytic) conversion of CO2 into value added compounds in a viable manner; the non-equilibrium conditions unlock thermodynamically unfavourable reaction pathways. Whilst commonly investigated in air-like mixtures, atmospheric pressure nanosecond repetitively pulsed (NRP) discharges are an interesting candidate for such research, showcasing high conversion rates, which are further improved operating in burst mode.

Previous work on NRP's in CO2 did focus on conditions and conversion just after a pulse. This contribution details research using time-resolved optical emission spectroscopy that investigated conditions inside the pulses of a burst itself, further developing understanding of the evolution of NRP CO2 discharges and the altered behavior due to the burst pattern. The Stark broadening of an oxygen line allowed the electron density to be estimated, while the N2 second positive system was used to determine the gas temperature.

The overall picture that arises from these observations is of a highly ionised spark discharge in quasi local thermodynamic equilibruim, as opposed to the thermal spark encountered in air-like mixtures. Based on time-resolved spectra, it appears that CO2 dissociation and O2 formation are both processes that occur over longer (>1 us) timescales and only occur after a delay, implying that other processes than electron impact play an important role.

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