

Energy transfer pathways in CO₂-containing DC discharges

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CO₂-containing plasmas constitute a hot topic nowadays, due to their importance in CO₂ reforming and the production of solar fuels [1,2] and in Mars-related studies [3,4]. A key step seems to reside in the selective excitation of the CO₂ asymmetric stretching vibrational mode, while limiting the losses by gas heating. The subsequent vibration-vibration (V-V) up-pumping may enhance dissociation and favour CO₂ conversion at a low energy cost [1,2]. This work presents a thorough theoretical, modelling and experimental investigation of discharges in pure CO₂ and in CO₂ mixtures with N₂, CH₄ and Ar and their afterglows, operating at pressures around 1 Torr, discharge currents of 10s of mA, either in a continuous or a pulsed regime. The basis of the model was presented in [5]. It comprises a detailed state-to-state kinetics of CO₂ vibrationally excited levels, coupled to the gas phase chemistry and to the homogeneous electron Boltzmann equation describing the electron kinetics. The model is validated from the comparison with the measurements of the populations of several heavy species, *e.g.* O, CO, CO₂(v) and C₂H_x. Several phenomena are presented and discussed, such as the transfer of vibrational energy from N₂ to the CO₂ asymmetric stretching mode, the efficiency of dry reforming of methane, the influence of shifting the electron energy distribution function to higher energies due to Ar addition, or the main routes towards enhanced reactivity.

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