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Modelling of a CO_2 coaxial plasma torch driven by microwave power pulsing

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As humanity is faced with the urgency of the climate crisis, already suffering from its consequences such as rising temperatures and severe weather events, one of the century's great challenges is to reduce emissions and find new, renewable energy sources.

The conversion of CO_2 , the biggest polluter, into oxygen and carbon monoxide, a valuable fuel, through the innovative use of non-thermal plasmas is the subject of this research. These plasmas have the exciting characteristic of generating highly energetic free electrons, which facilitate molecular bond breaking while maintaining the gas at relatively low temperatures.

The core of this work is the development of a theoretical model for a CO_2 coaxial plasma torch driven by microwave power pulsing, expanding upon a pre-existing hydrodynamical 2D model for helium, adapting it to the more complex structure of the CO_2 molecule and accounting for more processes like recombination of ions/ electrons and transport of neutral species. The simulation results will be compared to real, experimental data of the system established at the Karlsruhe Institute of Technology.

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