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Spatially-resolving Discharge Parameters in Microwave Plasmas for CO_2 Conversion from Atomic Oxygen Emission PEDRO VIEGAS, FLORAN PEETERS, BRAM WOLF, ALEX VAN DE STEEG, LUCA VIALETTO, PIETER-WILLEM GROEN, WALDO BONGERS, GERARD VAN ROOIJ, RICHARD VAN DE SANDEN, PAOLA DIOMEDE, DIFFER - Dutch Institute for Fundamental Energy Research — At DIFFER, microwave (MW) plasma reactors are used to efficiently convert CO_2 into carbon-neutral fuels and chemicals. The optimal conditions for these reactors have shown a strong correlation with pressure and discharge contraction dynamics and have been obtained in contracted plasma conditions. Characterization of the plasma parameters in these highly heterogeneous discharges often relies on estimations of the electron density and power density profiles. However, these profiles are determined from the experimentally measured radiative emission of atomic oxygen, under an unverified assumption of proportionality. In this work, a collisional-radiative model of O atom in CO_2 MW plasmas is used to complement the experiments and assess the validity of this assumption. The simulations relate the radiative emission of O atom with electron density, power density, and other discharge parameters, resolving their spatial profiles. The electron density is shown to have a broader profile than initially assumed, with implications on discharge contraction, which depends on ionisation and recombination rates. As a result of the combined experimental and numerical study, the contraction of the CO_2 MW discharge is explained through its relationship with charged particle kinetics.

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