GEC19-2019-000374

Abstract for an Invited Paper
for the GEC19 Meeting of
the American Physical Society

**Multi-diagnostic approach in homogeneous discharges to constrain effectively CO2 plasmas kinetic models**[1]

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CO2 plasmas are a good example of the difficulty of creating predictive models when too many basic data are very poorly known. We have chosen to study simple plasma discharges, but with the help of numerous and complementary diagnostics in order to establish sufficiently complete data sets to effectively constraint kinetic models of pure (or in gas mixtures) CO2 plasma. We used DC and RF discharges at a few mbar, in continuous, pulsed or modulated mode. The vibration temperatures of CO and CO2 were measured by time-resolved infrared absorption, but also by Raman scattering. The absolute densities and loss frequencies of the oxygen atoms were obtained by TALIF and actinometry but also with a new CRDS technique using the transition O(3P) ->O(1D) at 630 nm. Gas temperature, electric field and spatial density profiles were also measured. All these measurements made it possible, step by step, to isolate and determine essential parameters and to develop excellent and reliable comparisons with the models. As an example, by working in a closed reactor without gas flow, it has been possible to determine the direct electron impact dissociation cross-section of CO2 for which values with orders of magnitude of discrepancy exist in the literature. Different surfaces such as glass fibers with CeO2 are now being studied in contact with the plasma to promote conversion efficiency. Surface reactivity was studied by isotopic exchange monitored with infrared absorption, and with IR transmission measurements through solid pellets. All this work provides access to a detailed description of CO2 plasma, but a similar approach can be applied to other gases to move towards a systematic method of kinetic scheme validation.

[1]This work is partially funded by French National Research Agency (ANR) under reference ANR-16-CE06-0005-01