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Plasmas for in-situ resource utilization on Mars: fuels, life-support and agriculture

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Abstract
In this work we address the possibility of oxygen production directly from the CO_2-enriched Martian atmosphere using plasma technology. A local production of oxygen from CO_2 decomposition would reduce the logistics and costs of future missions, while providing a breathable environment for future human outposts, a source of rocket propellant and feed-stock and base chemicals for building materials and fertilizers. A combination of experimental and modelling efforts is used to explore different plasma sources, including DC glow discharges, nanosecond repetitively pulsed discharges and microwave discharges [1]. This diversity allows exploring different energy transfer pathways leading to CO_2 dissociation, including direct electron impact processes, plasma chemistry mediated by vibrationally and electronically excited states, and thermally-driven dissociation. Experimental results are validated against a volume average 0D self-consistent kinetic model accounting in detail for the very complex plasma chemistry. The model describes the kinetics of electrons and heavy species under Martian environment in terms of pressure and temperature, relying on the LisbOn Kinetics (LoKI) [2] simulation tool to solve the homoegenous two-term electron Boltzmann equation and the system of zero domentional rate balane equations for the most relevant charged and netrual species.

References
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