Keep-in-Touch meeting
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Microwave N_2 plasmas at intermediate pressures: modeling of excitation and transport

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In a N_2-O_2 plasma for NOx production, N_2 molecules are the toughest species. Their high dissociation energy makes out-of-equilibrium vibrational and electronic excitation desirable to lower the dissociation energy. A vortex-stabilized microwave (MW) discharge in pure N_2 is used to test the viability of these non-equilibrium conditions at intermediate pressures. This is done by means of laser scattering experiments and modeling of the discharge with a 0D global model and a 1D radial fluid model. The latter was developed to reveal the role played by transport in shifting the discharge chemical equilibrium.

Out-of-equilibrium vibrational excitation shown by experiments in continuous wave mode can be explained by the low electronic excitation. Nitrogen electronically excited states are in fact heavily involved in gas heating. The transient non-equilibrium observed in pulsed discharges can be explained in the same way in the same way in the plasma core, while diffusive transport of vibrationally excited species explains the high non-equilibrium observed in the region between the core and the tube wall. Though vibrational excitation is considered to be the main energy buffer in N_2 MW discharges, N_2 electronically excited states also deserve accurate modeling, due to their fundamental role in both heating and ionization mechanism.