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Picosecond CARS Measurements of Vibrational Distribution Functions in a High Pressure Non-Self-Sustained Discharge WALTER LEMPERT, AARON MONTELLO, MUNETAKE NISHIHARA, JOESEPH RICH, IGOR ADAMOVICH, Ohio State University — Picosecond Coherent Anti-Stokes Raman Scattering (CARS) is used for measurement of nitrogen Vibrational Distribution Function (VDF) in the plenum of a highly nonequilibrium Mach 5 wind tunnel incorporating a high pressure pulser-sustainer discharge. First level vibrational temperatures of the order of 2000 K are achieved in the 300 Torr non-self-sustained plasma discharge, generated by a high E/n (∼300 Td) nanosecond pulsed discharge, which provides ionization, in combination with an orthogonal low E/n (∼10 Td) DC sustainer discharge, which efficiently loads the nitrogen vibrational mode. It is also shown that operation with the nanosecond pulsed plasma alone results in significant vibrational energy loading, with $T_v(N_2)$ of the order of 1100 K. Downstream injection of CO_2, NO, and H_2 results in vibrational relaxation, demonstrating the ability to further tailor the vibrational energy content of the flow. N_2 – NO V-V and N_2 – H_2 V-T rates inferred from this data agree well with previous literature results, to within the uncertainty in rotational-translational temperature.

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