Non-resonant four wave mixing techniques for the thermodynamic characterization of neutrals, ions, electrons and nanoparticles in a gas discharge.

Single shot, non-resonant four wave mixing techniques show great promise for the thermodynamic characterization (density, temperature, flow velocity) of all constituents (heavy species - ion or neutrals - and electrons) present in a gas discharge. Single shot CRBS[1] has been demonstrated to be the coherent analog of spontaneous Rayleigh-Brillouin scattering in measuring the temperature, pressure, bulk and shear viscosity, speed of sound and polarizability of a gas or gas mixture[2], as well as nanoparticles produced in an arc discharge[3]. Additionally, four-wave mixing Thomson scattering[4] or the driving of Langmuir waves within the plasma[5] show great promise for the characterization of charged species. In this talk, an overview on the theory and experimental aspects[6,7] of all four-wave mixing techniques will be presented along with our recent and ongoing work in a) measuring simultaneously the temperature, density (and thus the pressure) and flow velocity[8,9] of neutral species in a neutral gas flow and radially across a glow discharge[10], b) measuring the translational temperature in the fast transition from partially ionized atmospheric pressure discharges to fully ionized thermal spark discharges and c) characterizing *in-situ* the nanoparticle production in a nanosecond repetitively pulsed (NRP) discharge.

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