Raman spectroscopy of N_2 in a chemically recombining plasma

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This presentation will summarize spontaneous Raman scattering measurements of N_2 density and temperature in a recombining N_2 plasma. These measurements are detailed in Refs. [1-3]. Briefly, a N_2/Ar plasma is formed at atmospheric pressure and with a temperature of approximately $7{,}000\ K$ using an inductively coupled plasma torch. The plasma is initially in chemical equilibrium. Next, the equilibrium plasma is forced to recombine by passing it at high speed through a water-cooled recombination tube (see Figure 1). This water-cooled tube causes a rapid drop in temperature and induces recombination kinetics. Spontaneous Raman scattering measurements are used to track the evolution of gas temperature and N_2 density as the mixture passes through the tube. The results are combined with measurements performed using Optical Emission Spectroscopy (OES) to determine the chemical state of the plasma. The measurements indicate that a strong level of chemical nonequilibrium exists at the output of the water-cooled tube.

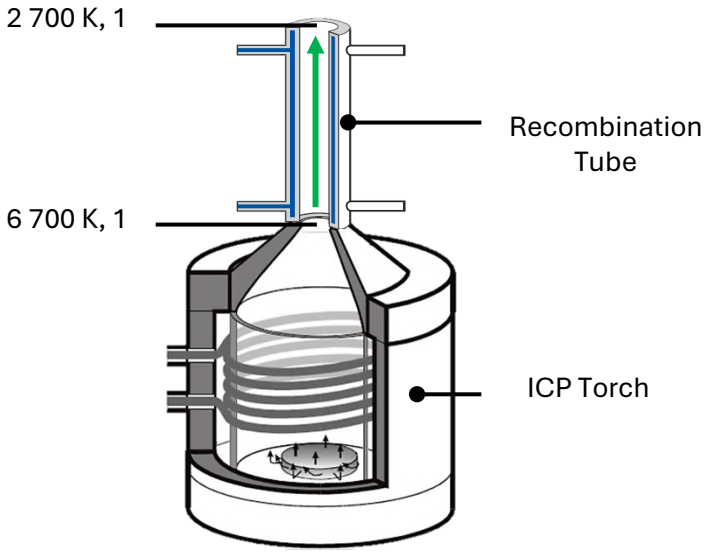

Figure 1. The water-cooled recombination tube used for experiments is mounted above the nozzle exit of the inductively coupled plasma torch which produces the high temperature plasma. The recombination tube rapidly cools the plasma – which remains at atmospheric pressure – and triggers chemical recombination

1. Tibère-Inglesse, A.C., et al., Plasma Sources Science and Technology, 2018. **27**(11): p. 115010.
2. McGuire, S.D., A.C. Tibère-Inglesse, and C.O. Laux, Plasma Sources Science and Technology, 2017. **26**(11): p. 115005.
3. Tibère-Inglesse, A., Ph.D Thesis, 2019, Université Paris-Saclay.