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Electron Number Density Decay in Nitrogen Afterglow Using a Microwave Hairpin Resonator NICHOLAS SIEFERT, BISWA GANGULY, Air Force Research Laboratory WPAFB, GREG HEBNER, Sandia National Lab, AIR FORCE RESEARCH LABORATORY COLLABORATION — A microwave hairpin resonator probe has been built to measure the decay of the electron number density in nitrogen afterglow (p = 0.25 & 0.75 Torr). In order to operate at these pressures, it was necessary to make corrections for both sheath and collisional damping. In order to measure the change in electron number density in the afterglow, it was necessary to convert the hairpin resonator probe from a steady-state diagnostic tool into a time-dependent one. The results presented in this work will show that both the steady state and time dependent electron density measurements are reasonably accurate up to a pressure of 0.75 Torr, but only over a limited range of electron number densities ($5\text{x}10^8$ cm^3 $< n_e <$ $5\text{x}10^9$ cm^3). For pressures at or below 0.75 Torr, the error due to electron-neutral collisions is less than three percent. Using the e-folding decay time of the electron number density, we solve the ambipolar diffusion equation to determine the mean electron temperature in the afterglow. We estimate that the electron temperature stays between 0.7 eV and 1.3 eV for up to a few hundred microseconds after the discharge is switched off.

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