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Cooling of Electronically-Excited Diatomic Molecules in a Supersonic Microplasma Jet THOMAS J. HOULAHAN, JR., RUI SU, J. GARY EDEN, Univ of Illinois - Urbana — Electronically-excited diatomic molecules having natural lifetimes as short as 16 ns have been cooled in a microplasma jet. By integrating a cylindrical microcavity plasma device with a nozzle, rotational cooling of He_2 molecules in the $d^3\Sigma_u^+$, $e^3\Pi_g$ and $f^3\Sigma_u^+$ states (radiative lifetimes of 25 ns, 67 ns, and 16 ns, respectively) have been observed. Cooling of He dimers in the $d^3\Sigma_u^+$ state from $\sim$1200 K to temperatures below 250 K has been realized and, as a result of the sub-10 μm spatial resolution of our present optical imaging capability, the temporal evolution of the non-equilibrium rotational distribution can be monitored with <10 ns resolution. Furthermore, evidence of excitation transfer between rotational levels of the $f^3\Sigma_u^+$ state and the lower lying $d^3\Sigma_u^+$ and $e^3\Pi_g$ states has been observed. Dynamics of the non-equilibrium cooling process, and the extension of the method to other electronically-excited diatomics with internal energies of >5 eV, will be discussed.

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