

SHORT-LIVED ELECTRONICALLY-EXCITED DIATOMIC MOLECULES COOLED VIA SUPERSONIC EXPANSION FROM A PLASMA MICROJET

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Using a pulsed plasma microjet to generate short-lived, electronically-excited diatomic molecules, and subsequently ejecting them into vacuum to cool via supersonic expansion, we are able to monitor the cooling of molecules having radiative lifetimes as low as 16 ns. Specifically, we report on the rotational cooling of He₂ molecules in the $d^3\Sigma_u^+$, $e^3\Pi_g$, and $f^3\Sigma_u^+$ states, which have lifetimes of 25 ns, 67 ns, and 16 ns, respectively. The plasma microjet is driven with a 2.6 kV, 140 ns high-voltage pulse (risetime of 20 ns) which, when combined with a high-speed optical imaging system, allows the nonequilibrium rotational distribution for these molecular states to be monitored as they cool from 1200 K to below 250 K with spatial and temporal resolutions of below 10 μm and 10 ns, respectively. The spatial and temporal resolution afforded by this system also allows the observation of excitation transfer between the $f^3\Sigma_u^+$ state and the lower lying $d^3\Sigma_u^+$ and $e^3\Pi_g$ states. The extension of this method to other electronically excited diatomics with excitation energies >5 eV will also be discussed.