

MEASUREMENTS OF VIBRATIONALLY EXCITED OXYGEN MOLECULES IN PREHEATED O<sub>2</sub>-Ar MIXTURES EXCITED BY A NANOSECOND PULSE DISCHARGE

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Kinetics of O<sub>2</sub> vibrational excitation is studied during the O atom recombination in an O<sub>2</sub>-Ar mixture partially dissociated by a burst of ns discharge pulses in a heated flow reactor at T=400-800 K and P=200-600 Torr. Time-resolved vibrational level populations of molecular oxygen in the ground electronic state, O<sub>2</sub>(v=8-13,17-20), are measured by ps Laser Induced Fluorescence on the O<sub>2</sub> Schumann Runge bands, with absolute calibration by NO LIF in a NO-N<sub>2</sub> mixture with a known composition, at quenching-free conditions. O atom number density in the same mixture is measured by ps Two-Photon absorption LIF (TALIF). The discharge generates a diffuse volumetric plasma, without well-pronounced filaments. The results indicate a rapid initial decay of the O<sub>2</sub>(X,v=8-20) molecules generated by electron impact in the discharge, on 20 μs time scale, due to the V-V exchange and V-T relaxation. This decay is followed by a much slower decay, on the time scale much longer compared to the characteristic time for V-V relaxation, 1 ms. This indicates an additional process of O<sub>2</sub>(v) generation by chemical reactions initiated by the O atom recombination and possibly ozone chemistry. Comparison of the experimental data with the master equation kinetic modeling predictions is used to infer the state-specific rates of chemical reactions generating vibrationally excited O<sub>2</sub>.