INVESTIGATION OF $O_2(C^3\Pi$, v=2) BY NOVEL LASER PHOTOIONIZATION TECHNIQUE IN AIR AT ATMOSPHERIC PRESSURE

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We have used pulsed laser photoionization of dry atmospheric air for the analysis of the $O_2(X^3\Sigma \rightarrow C^3\Pi)$ excitation spectrum and improved characterization of the $O_2(C^3\Pi)$ Ryberg state. This $^3\Pi$ Ryberg state is generally very diffuse due to predissociation, but using this method, reasonable resolution in the rotational structure of the v=2 level was achieved. A simulated $O_2(X^3\Sigma \rightarrow C^3\Pi)$ excitation spectrum was calculated for line position, intensity, and linewidth that agreed very well with the experiment, providing values for ν_0, B_{eff}, and D_{eff} for the F1, F2, and F3 subbands of $O_2(C^3\Pi$, v=2). The photoionization technique involved a combination of resonant-enhanced multi-photon ionization (REMPI), collisional excitation, and laser-induced fluorescence. A focused, ultraviolet laser pulse was used to excite the $O_2(X^3\Sigma \rightarrow C^3\Pi)$ resonant transition. The near coincident energy between the $O_2(C^3\Pi$, v=2) state and the $N_2(a'^1\Sigma_u^-$, v=1) state resulted in rapid collisional transfer of energy to the $N_2(a')$ state. The $N_2(a')$ molecules were then photoionized by the same laser pulse to the $N_2{}^+(B)$ state, producing an easily observable fluorescence at 391 nm. By scanning the laser wavelength while observing the 391 nm fluoresence, details of the $O_2(C^3\Pi)$ Ryberg state could be studied.