Ozone recovery in the presence of CO

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The temporal profiles of ozone number densities after pulsed UV laser photolysis in a gas mixture O_2-O_3-Ar-CO obtained by time-resolved absorption spectroscopy was presented. The experimental results demonstrated the dominance of the stabilization channel over the reactive one for the reaction of O_3 (υ) with CO. The rate constants for the processes $O_3(\upsilon) + CO \rightarrow O_3 + CO$ was obtained to be $(1.5\pm0.2) \times 10^{-13}$ cm^3/s using kinetics modeling of experimental data.

There are some experimental data showing the high reactive activity of vibrationally excited ozone $O_3(\upsilon)$ [1–4] which, in the presence of O atoms and O_2 molecule excess (fuel–air mixtures, upper atmosphere layers, oxygen-containing plasma, and others), are efficiently generated in the recombination process $O + O_2 + M \leftrightarrow O_3(\upsilon) + M$, (1), where M is the third body.

The reaction of vibrationally excited ozone with carbon monoxide at moderate temperatures can proceed in two possible channels: reaction channel $O_3(\upsilon) + CO \rightarrow CO_2 + O_2$, (2),

stabilization channel $O_3(\upsilon) + CO \rightarrow O_3 + CO$. (3)

In this work, we present the time dependences of the ozone concentration in the region after photolysis as a function of the carbon monoxide content in the O_2-O_3-Ar-CO initial mixture, measured using pulsed laser equipment and time-resolved emission spectroscopy.

Figure 2 shows the typical time dependences of the ozone concentration after laser photolysis of mixture O_2-O_3-Ar-CO at a wavelength of 266 nm for specific pulse energy E = 70 mJ/cm^2, total gas pressure P_{tot} = 720 Torr, oxygen pressure P_{O2} = 180 Torr, gas mixture temperature T = 300 K, and initial ozone pressure P_{O3} = 0.85 Torr.

Kinetic modeling of processes in the photolysis cell during experiments was performed. The best agreement with experimental data was achieved at the process (3) rate constant of $(1.5 \pm 0.2)\ 10^{-13}$ cm^3/s.

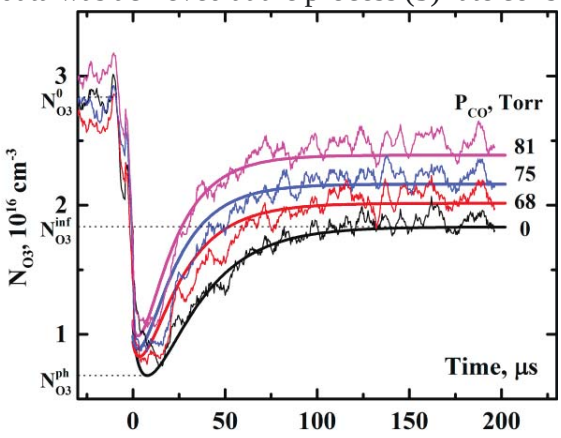

Figure 1 – Time profiles of the O_3 concentration at E = 70 mJ/cm^2, P_{tot} = 720 Torr, P_{O2} = 180 Torr, T = 300 K, and various CO pressures. Smooth curves are time profiles calculated by kinetic modeling.

References

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