

1C3b

Rate coefficients for vibrational relaxation of
 $C_2H(\tilde{X}^2\Sigma^+)$ by collision with HeRintaro Fukami,¹ Daigo Kawabata,¹ Yuki Tanimoto,¹Shogo Tendo,¹ Hiroshi Kohguchi,¹ Katsuyoshi Yamasaki¹¹ Department of Chemistry, Graduate School of Science, Hiroshima University

Ethynyl (C_2H) is one of the most abundant radical in the combustion system of hydrocarbons and interstellar clouds. The rate coefficients for the reactions of the vibrationless state of $C_2H(\tilde{X}^2\Sigma^+)$ have been measured; however, no report on the kinetics of the vibrationally excited levels has been made. In this study, we have determined the rate coefficients for vibrational relaxation of $C_2H(\tilde{X}^2\Sigma^+, v_2 = 5, 6)$ by He.

A gaseous mixture of C_2H_2 (11 mTorr) and He (1–10 Torr) in a flow cell at 298 K was irradiated with excimer laser light at 193 nm. $C_2H(\tilde{X}^2\Sigma^+, v_2 = 5-7)$ was detected by laser-induced fluorescence (LIF) technique via the $\tilde{B}^2A' - \tilde{X}^2\Sigma^+$ transition (Fig. 1).

The time-resolved LIF intensities of the vibrational levels were recorded at varying pressures of He (Fig. 2). Both growth and decay are greatly accelerated with an increase in He pressures by a few Torr. The fact indicates that He is an efficient relaxation partner of $C_2H(\tilde{X}^2\Sigma^+, v_2)$. Kinetic analysis by the integrated profiles method has been made on the assumption that relaxation occurs between adjacent levels. The resultant pseudo 1st-order rates k_{1st} were plotted against $[He]$ (Fig. 3). The rate coefficients for vibrational relaxation of $C_2H(\tilde{X}^2\Sigma^+, v_2)$ by He have been determined to be 3.0×10^{-12} and 5.0×10^{-12} cm^3 molecule⁻¹ s⁻¹, for $v_2 = 5$ and 6, respectively.

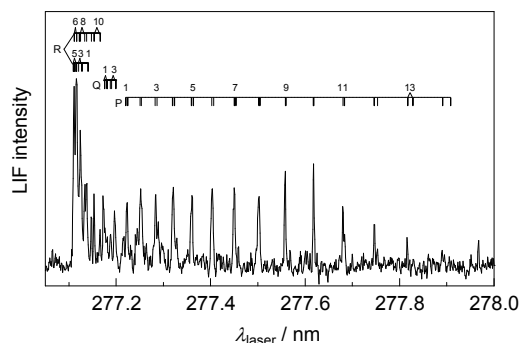


Fig. 1. LIF excitation spectrum of $C_2H(\tilde{B} - \tilde{X}(0, 7^1, 0))$. The numbers are the angular momentum quantum numbers N . $p(C_2H) = 11$ mTorr, $p(He) = 10$ Torr.

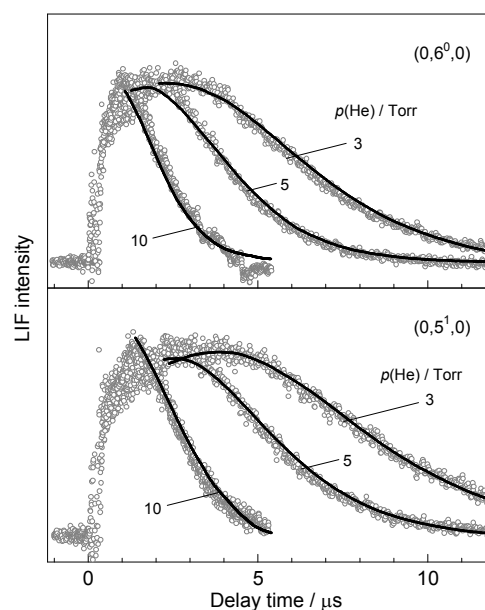


Fig. 2. Time-resolved LIF intensities of $C_2H(\tilde{X}^2\Sigma^+, v_2 = 5, 6)$ at varying pressures of He. The black lines denote simulation.

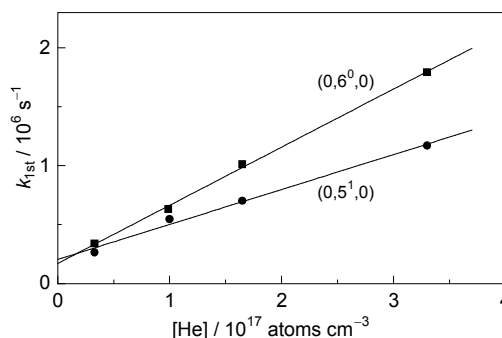


Fig. 3. $[He]$ -dependence of the pseudo 1st-order relaxation rates of $C_2H(\tilde{X}^2\Sigma^+, v = 5, 6)$.