

MEASUREMENT AND MODELING OF PROPYLENE IGNITION DELAYS BEHIND REFLECTED SHOCK WAVES

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Abstract: An experimental and computational study of propylene ignition behind reflected shock waves was carried out. The experiments were performed with propylene–oxygen–argon mixtures with stoichiometric ratios $\varphi = 0.5$, 1.0, and 2.0 in the temperature range of 1450–1740 K at pressures of ~ 1.2 –1.4 atm. Information on the ignition process was obtained by recording light absorption at wavelengths of 197 ± 1.0 and 230 ± 1.0 nm and emission from electronically excited OH* radicals at $\lambda = 308 \pm 2.0$ nm. The temperature dependences of the ignition delays of these mixtures and the time profiles of the optical absorption density of propylene and its conversion products were measured. The experimental data were interpreted within the framework of the Konnov kinetic mechanism. Good agreement is observed between experimental and computational results.

Keywords: propylene ignition; ignition delays; shock waves; spectrophotometry; kinetic modeling

DOI: 10.30826/CE25180301

EDN: WSXAEX

Figure Captions

Figure 1 Time profiles of pressure (a), optical density at a wavelength of 197 nm (b), and emission intensity of electronically excited OH* radicals normalized to unity (c) at an initial temperature of $T_{50} = 1534$ K and pressure of $P_{50} = 1.24$ atm

Figure 2 Time profiles of pressure (a), optical density at a wavelength of 230 nm (b), and emission intensity of electronically excited OH* radicals normalized to unity (c) at an initial temperature of $T_{50} = 1537$ K and pressure of $P_{50} = 1.24$ atm

Figure 3 Experimental (1) and calculated (2) temperature dependences of the ignition delay time for 0.25% C_3H_6 + 2.25% O_2 + Ar ($\varphi = 0.5$) (a), 0.5% C_3H_6 + 2.25% O_2 + Ar ($\varphi = 1.0$) (b), and 1.0% C_3H_6 + 2.25% O_2 + Ar ($\varphi = 2.0$) (c) mixtures

Figure 4 Sensitivity coefficients of ignition delay to reactions that have the most significant effect at $T = 1450$ (1) and 1700 K (2) for a mixture of 0.5% C_3H_6 + 2.25% O_2 + Ar ($\varphi = 1.0$)

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Received December 27, 2024

After revision February 24, 2025

Accepted March 3, 2025

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