The experimental study of $\text{C}_3\text{F}_7\text{I}$ dissociation kinetics using atomic and molecular resonance absorption spectroscopy methods

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Currently, halogenated hydrocarbons are widely used in various industries for increasing explosion safety. However, the need to protect the ozone layer of the Earth’s atmosphere has pushed to search for new, efficient and at the same time environmentally friendly fire extinguishing substance. Among the most promising additives, iodine-containing halogenated hydrocarbons, including $\text{C}_3\text{F}_7\text{I}$, are of increasing interest. The molecules of $\text{C}_3\text{F}_7\text{I}$ are completely ozone-friendly and non-toxic for humans. Nevertheless, for industrial application, it is first necessary to investigate in detail the kinetics of dissociation of both $\text{C}_3\text{F}_7\text{I}$ and its secondary components. Reaction $\text{C}_3\text{F}_7\text{I} + \text{Ar}$ reaction was studied by sequential application of atomic and molecular resonance absorption spectroscopy using resonance line I at 183.04 nm and $\text{CF}_2$ radical band at 251.9 nm behind reflected shock waves. The experiments were performed at the temperatures from 900 to 1500 K and pressures of 2.5 to 16 bar. The initial concentration of $\text{C}_3\text{F}_7\text{I}$ in Ar varied from 1 to 500 ppm. The time profiles of $\text{CF}_2$ and I concentration, forming at $\text{C}_3\text{F}_7\text{I}$ dissociation were obtained. From these experimental data the temperature dependences of the rate constants of $\text{CF}_2$ and I formation and their activation energy were determined. This fact allowed to study in detail the kinetic mechanism of $\text{C}_3\text{F}_7\text{I}$ decomposition in a wide range of temperatures. This work has been supported by grant from the Russian Science Foundation No. 14-19-00025P.