

OH Radical Chemistry of Hydrofluoroolefins: CHF=CF₂ Rate Coefficient Measurements and OH Radical Regeneration

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Hydrofluoroolefins (HFOs) are the next generation of chlorofluorocarbon (CFC) replacement compounds. HFOs are, in general, potent greenhouse gases and their commercial use will lead to their release into the atmosphere. Hydrofluoroolefins are attractive replacement compounds from an atmospheric chemistry perspective due to their reactivity with the OH radical and expected short atmospheric lifetimes, which minimizes their climate impact. A comprehensive understanding of the atmospheric chemistry of a HFO replacement compound is a key element in the determination of its environmental acceptability. CHF=CF₂ (trifluoroethylene, HFO-1123) is a proposed replacement compound and its reaction with the OH radical:



is expected to proceed via OH radical addition to the carbon-carbon double bond and the formation of a semi-stable OH–CHF=CF₂ radical adduct.

In this work, rate coefficients for reaction (1) were measured under pseudo first-order conditions using pulsed laser photolysis to produce OH radicals and pulsed laser induced fluorescence (PLP-LIF) to measure the OH radical temporal profile. Rate coefficients were measured over the temperature range 212–375 K at total pressures between 20 and 500 Torr (He, N₂). Rate coefficients for the reaction of CHF=CF₂ with ¹⁸OH and OD were also measured at 296 and 373 K and a total pressure of 25 Torr (He) as part of this study. These measurements were used to investigate the OH radical regeneration that was most clearly observed under the low-pressure (20 Torr He) and high-temperature (375 K) of our experiments with an enhanced rate in the presence of O₂. CHF=CF₂ was determined to be a very short-lived substance (VSLS) with an atmospheric lifetime of ~1 day with respect to OH reactive loss. The actual lifetime of CHF=CF₂ will depend on the time and location of its emission. Global warming potentials (GWPs) were estimated using the 296 K infrared absorption spectrum of CHF=CF₂ measured in this work. The atmospheric degradation of CHF=CF₂ will also be discussed.