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## The atmospheric chemistry of sulphuryl fluoride, SO<sub>2</sub>F<sub>2</sub>

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**Abstract.** The atmospheric chemistry of sulphuryl fluoride, SO<sub>2</sub>F<sub>2</sub>, was investigated in a series of laboratory studies. A competitive rate method, using pulsed laser photolysis (PLP) to generate O(<sup>1</sup>D) coupled to detection of OH by laser induced fluorescence (LIF), was used to determine the overall rate coefficient for the reaction O(<sup>1</sup>D) + SO<sub>2</sub>F<sub>2</sub> → products (R1) of  $k_1$  (220–300 K) =  $(1.3 \pm 0.2) \times 10^{-10} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$ . Monitoring the O(<sup>3</sup>P) product (R1a) enabled the contribution ( $\alpha$ ) of the physical quenching process (in which SO<sub>2</sub>F<sub>2</sub> is not consumed) to be determined as  $\alpha$  (225–296 K) =  $(0.55 \pm 0.04)$ . Separate, relative rate measurements at 298 K provided a rate coefficient for reactive loss of O(<sup>1</sup>D),  $k_{1b}$ , of  $(5.8 \pm 0.8) \times 10^{-11} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$  in good agreement with the value calculated from  $(1-\alpha) \times k_1 = (5.9 \pm 1.0) \times 10^{-11} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$ . Upper limits for the rate coefficients for reaction of SO<sub>2</sub>F<sub>2</sub> with OH (R2, using PLP-LIF), and with O<sub>3</sub> (R3, static reactor) were determined as  $k_2$  (294 K)  $< 1 \times 10^{-15} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$  and  $k_3$  (294 K)  $< 1 \times 10^{-23} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$ . In experiments using the wetted-wall flow tube technique, no loss of SO<sub>2</sub>F<sub>2</sub> onto aqueous surfaces was observed, allowing an upper limit for the uptake coefficient of  $\gamma(\text{pH } 2\text{--}12) < 1 \times 10^{-7}$  to be determined. These results indicate that SO<sub>2</sub>F<sub>2</sub> has no significant loss processes in the troposphere, and a very long stratospheric lifetime. Integrated band intensities for SO<sub>2</sub>F<sub>2</sub> infrared absorption features between 6 and 19  $\mu\text{m}$  were obtained, and indicate a significant global warming potential for this molecule. In the course of this work, ambient temperature rate coefficients for the reactions O(<sup>1</sup>D) with several important atmospheric species were determined. The results (in units of  $10^{-10} \text{ cm}^3 \text{ molecule}^{-1} \text{ s}^{-1}$ ,  $k_{(\text{O}^1\text{D} + \text{N}_2)} = (0.33 \pm 0.06)$ ;  $k_{(\text{O}^1\text{D} + \text{N}_2\text{O})} = (1.47 \pm 0.2)$  and  $k_{(\text{O}^1\text{D} + \text{H}_2\text{O})} = (1.94 \pm 0.5)$ ) were in good agreement with other recent determinations.

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