

IUPAC Task Group on Atmospheric Chemical Kinetic Data Evaluation – Data Sheet V.A4.10 HSTD10

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This data sheet last evaluated: January 2009; last change in preferred values: January 2009.



Experimental data

Parameter	Temp./K	Reference	Technique/ Comments
<i>Uptake coefficients: γ</i>			
$0.162 + 0.789 \times \log P_{\text{H}_2\text{O}}$	210	Zhang et al., 1995	CWFT-MS (a)
$4.78 - 0.0386 \times T$ ($P_{\text{H}_2\text{O}} = 2 \times 10^{-5}$ Torr)	200-225		

Comments

- (a) Sulphuric acid monohydrate was generated by freezing a liquid film (≈ 0.1 mm thick, ≈ 85 wt. %). The relative humidity above the film was varied by adjusting the temperature at fixed H_2O partial pressure or vice-versa. The geometric surface area was used to calculate the uptake coefficient. Experiments were conducted with $[\text{N}_2\text{O}_5]$ at $\approx 4\text{-}7 \times 10^{-7}$ Torr which was ionised by electron impact or CIMS. Note that the authors reported $\gamma = 0.162 - 0.789 \times \log P(\text{H}_2\text{O})$, which appears to have a sign error.

Preferred Values

Parameter	Value	T/K
γ	$RH * 4.63 \times 10^{-4} + 2.6 \times 10^{-4}$ (RH in %)	200 – 225 K

Reliability

$\Delta \log \gamma_{\text{net}}$	0.5	200 – 225
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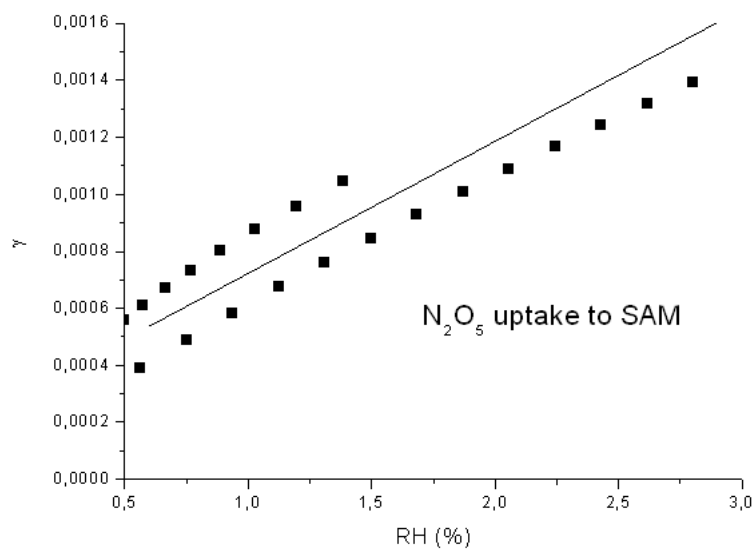
Comments on Preferred Value

The only study (Zhang et al, 1995) of the hydrolysis of N_2O_5 on sulphuric acid monohydrate showed that the process is much less efficient (\approx factor 50) than on liquid H_2SO_4 and displayed a strong dependence on the water vapour partial pressure and the temperature (see expressions given in the Table) with γ (210 K) increasing by a factor of 5 going from $P_{\text{H}_2\text{O}} = 1 \times 10^{-5}$ Torr to $P_{\text{H}_2\text{O}} = 1 \times 10^{-4}$ Torr. This represents a change in RH from ≈ 0.3 to 3 %. Higher values of RH would have caused a phase change to SAT and were thus not possible. Similar results were obtained when the partial pressure of H_2O was held at 2×10^{-5} torr and the temperature was varied (200 – 225 K). The preferred values of γ were obtained by combining these two data sets by plotting γ versus RH, defined as $\text{RH} = 100 * p(\text{H}_2\text{O}) / \text{Pice}(T)$ with values of the vapour pressure of H_2O over ice taken from Marti and Mauersberger (1993).

References

Marti, J. and Mauersberger, K.: Geophys. Res. Lett. 20, 363-366, 1993.

Zhang, R. Y., Leu, M. T. and Keyser, L. F.: Geophys. Res. Lett. 22, 1493-1496, 1995.



Uptake of N₂O₅ to SAM, data of Zhang et al. (1995): Dependence of γ on relative humidity (RH). The lowest data (parameterised) were obtained at 210 K, the uppermost data set (parameterised) was obtained by varying T at fixed $p(\text{H}_2\text{O}) = 2 \times 10^{-5}$ Torr. The solid line represents the preferred values.