

## IUPAC Task Group on Atmospheric Chemical Kinetic Data Evaluation – Data Sheet V.A1.2 HI2

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### O<sub>3</sub> + ice

#### Experimental data

Parameter	Temp./K	Reference	Technique/ Comments
<i>Experimental uptake coefficients: <math>\gamma</math></i>			
$\gamma < 1 \times 10^{-4}$	195	Leu, 1988	CWFT-MS (a)
$\gamma < 1 \times 10^{-6}$	195-262	Dlugokencky and Ravishankara, 1992	CWFT-CL (b)
$\gamma < 6 \times 10^{-5}$	183	Kenner et al., 1993	CWFT-MS (c)
$\gamma = 2 \times 10^{-8} - 4 \times 10^{-10}$	223, 258	Langenberg and Schurath, 1999	(d)

#### Comments

- (a) Ice film made by vapour deposition. No uptake of O<sub>3</sub> on pure ice detected
- (b) Low pressure flow tube (1.33 mbar He). 2 mm thick ice film formed by freezing liquid water. O<sub>3</sub> was varied between 10<sup>8</sup> and 10<sup>12</sup> molecule cm<sup>-3</sup>. No detectable O<sub>3</sub> loss on pure ice surfaces. Addition of e.g. sulphite or nitric acid prior to freezing induced temporary uptake.
- (c) 4-7  $\mu\text{m}$  thick ice film made by vapour deposition. No uptake of O<sub>3</sub> on pure ice detected.
- (d) Fused silica gas chromatographic column used as flow tube. Ice films were prepared by vapour deposition and were 6.8 – 8.1  $\mu\text{m}$  thick. O<sub>3</sub> (20-1000nbar) was detected using chemiluminescence. The O<sub>3</sub> uptake coefficient was found to be dependent on [O<sub>3</sub>], with higher values obtained at lower [O<sub>3</sub>]. Data at 223 K could be parameterised using  $\gamma = A/\{(1+B)C\}$ , whereby  $A = 5.5 \times 10^{-8}$ ,  $B = 0.08$  and  $C =$  the O<sub>3</sub> concentration in mbar.

#### Preferred Values

Parameter	Value	T/K
$\gamma$	$< 1 \times 10^{-8}$	220 - 260
<i>Reliability</i>		
$\Delta \log(\gamma)$	0.7	

#### Comments on Preferred Values

The four studies of the uptake on ozone to ice surfaces show that this process is very inefficient. Only the experiments of Langenberg and Schurath (1999), designed to measure weak interactions, were able to detect uptake of ozone and their data provide the basis of the

recommendation. Langenberg and Schurath provided a parameterisation of the [O<sub>3</sub>] dependent uptake coefficient at 223 K (see note (d) above), but were unable to treat data at 258 K in a similar fashion. For this reason, and also because the true surface area of the ice film could not be determined, an upper limit of  $1 \times 10^{-8}$  is preferred.

### References

- Dlugokencky, E. J., and Ravishankara, A. R.: Geophys. Res. Lett. 19, 41-44, 1992.  
Langenberg, S., and Schurath, U.: Geophys. Res. Lett. 26, 1695-1698, 1999.  
Leu, M. T.: Geophys. Res. Lett. 15, 851-854, 1988.  
Kenner, R. D., Plumb, I. C., Ryan, K. R.: Geophys. Res. Lett. 20, 193-196, 1993.