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This data sheet first evaluated: May 2009.

NH₃ + H₂O (water droplets)

Experimental data

Parameter	Temp./K	Reference	Technique/ Comments
Uptake coefficients: $\gamma, \gamma_{ss}, \gamma_0$			
$0.040^{+0.03}_{-0.005}$	299	Bongartz et al., 1995	LJ-IC (a)
0.097 ± 0.009	290	Ponche, George and Mirabel, 1993	DT-FTIR/HPLC (b)
0.1 (pH=0.5 - 3.0)	291	Shi et al., 1999	DT-FTIR/MS (a)
0.06 (pH=8)	291		
0.006 (pH=10 - 13)	291		
0.35 (pH=0.5 - 3.0)	260		

Comments

(a) Uptake of NH_3 in a liquid jet of dilute HCl solution with continuous measurement of NH_4^+ in the collected jet waters. Contact time of 0.1 ms to 0.8 ms virtually free of saturation effects in the liquid phase. The γ values for air (+He) as carrier gas agreed very well with those measured in He ($\gamma = 3.5$ x 10^{-2} in air vs. 4.0 x 10^{-2} in He).

(b) Gas interaction with monodisperse (70 μm to 110 μm diameter) droplet train propagating axially in a low pressure (46 mbar to 93 mbar) flow tube. Uptake determined by ion chromatographic analysis of collected aqueous phase was independent of pH in the range 4.2 to 11.5 but dependent on the contact time and pressure. The value listed in the table has been corrected for gas phase diffusion. The measured average uptake coefficient γ_{obs} was (2.4 ± 1.0) x 10^{-2} at 93 mbar N_2 and 290 K, obtained by extrapolation to zero interaction time.

(b) Uptake experiment of gas phase NH_3 on train of droplets whose size was in the range 150-300 μm entrained in a flowing mixture of helium and water vapour (between 2.9 and 23.3 mbar). The reaction time was between 2 and 15 ms, the ammonia concentration was in the range 10^{13} to $2x10^{14}$ cm^{-3} and was monitored using a VUV lamp emitting at $\lambda = 121.6$ nm. The theoretical framework included gas phase diffusion of ammonia, mass accommodation, dissolution, bulk and surface reaction whose relative contributions changed with pH. The effective Henry's law solubility was measured in the range 264 to 350 K: $\log(H) = -3.221 +1396/T$. The uptake coefficient was dependent on pH, falling rapidly from ~ 0.08 at pH=7 to 0.006 at pH=10. At low pH there is a negative temperature dependence of γ, which is attributed to accommodation controlled uptake. At high pH, NH_3 is less soluble and uptake controlled by a surface complex is suggested. Co-deposition with SO_2 enhanced the ammonia uptake to values corresponding to acidic solutions.

Preferred Values

Parameter	Value	T/K
α	0.1	290
α	0.1	260 -300
	Reliability	
$\Delta \log (\gamma)$	± 0.3	290

Comments on Preferred Values

The uptake coefficients on pure water, measured using the droplet train technique are somwhatt larger than onto dilute HCl in a liquid jet. Both methods require correction for gas phase diffusion and for saturation effects. On balance the DT experiment gives more reliable data we base the recommendation of the results of Ponche et al.(1993) and Shi et al., 1999), who also determined the temperature dependence at pH = 1. The value is higher than usually observed for the mass accommodation coefficient, α_B, for uptake on pure water, and the strong dependence of γ on pH (Shi et al., 1999), indicates a direct chemical interaction of NH_3 at the surface, e.g. by protonation.

References

Bongartz, A., Schweighoefer, S., Roose, C. and Schurath, U.: J. Atmos. Chem. 20, 35 (1995).
Ponche, J.L., George, Ch. and Mirabel, Ph.: J. Atmos. Chem. 16, 1 (1993).
Shi, Q., Davidovits, P., Jayne, J.T., Worsnop, D.R. and Kolb, C.E.: J. Phys. Chem. A 103, 8812 (1999).