

Electronic supplementary information (ESI)

Table ESI-1 : Condensation rate constant, k_c , evaporation rate J_{ev} and equilibrium vapor pressure P_{eq} for C_2 ice using a dose of 5.0×10^{16} molecule/pulse of H_2O .

Temperature(K)	$k_c(s^{-1})^*$	F_{ss} $\pm 5 \times 10^{13} (\text{molecules s}^{-1})$	$F_{ev}(\text{molecule s}^{-1})$	$J_{ev}(\text{molecule s}^{-1} \text{cm}^{-2})$	$P_{eq}(\text{Torr})$
160	55.7 ± 1.4	3.00×10^{14}	$(2.65 \pm 0.70) \times 10^{15}$	$(1.50 \pm 0.40) \times 10^{14}$	$(5.90 \pm 1.70) \times 10^{-7}$
160	48.6 ± 4.0	2.60×10^{14}	$(2.04 \pm 0.71) \times 10^{15}$	$(1.16 \pm 0.40) \times 10^{14}$	$(5.20 \pm 2.23) \times 10^{-7}$
165	51.0 ± 1.4	8.63×10^{14}	$(7.07 \pm 1.10) \times 10^{15}$	$(4.00 \pm 0.62) \times 10^{14}$	$(1.74 \pm 0.32) \times 10^{-6}$
165	56.6 ± 1.6	7.18×10^{14}	$(6.44 \pm 1.09) \times 10^{15}$	$(3.65 \pm 0.62) \times 10^{14}$	$(1.43 \pm 0.28) \times 10^{-6}$
170	47.7 ± 1.0	2.69×10^{15}	$(2.08 \pm 2.29) \times 10^{16}$	$(1.18 \pm 0.13) \times 10^{15}$	$(5.56 \pm 0.73) \times 10^{-6}$
175	38.9 ± 2.3	5.72×10^{15}	$(3.71 \pm 0.51) \times 10^{16}$	$(2.10 \pm 0.29) \times 10^{15}$	$(1.23 \pm 0.24) \times 10^{-5}$
175	48.0 ± 1.3	5.27×10^{15}	$(4.10 \pm 0.22) \times 10^{16}$	$(2.32 \pm 0.25) \times 10^{15}$	$(1.10 \pm 0.15) \times 10^{-5}$
180	43.3 ± 2.3	1.39×10^{16}	$(9.89 \pm 1.25) \times 10^{16}$	$(5.60 \pm 0.71) \times 10^{15}$	$(3.00 \pm 0.54) \times 10^{-5}$
180	51.5 ± 2.1	1.49×10^{16}	$(1.23 \pm 0.14) \times 10^{17}$	$(6.97 \pm 0.80) \times 10^{15}$	$(3.14 \pm 0.49) \times 10^{-5}$
183	55.3 ± 1.8	2.50×10^{16}	$(2.20 \pm 0.23) \times 10^{17}$	$(1.24 \pm 0.13) \times 10^{16}$	$(5.26 \pm 0.72) \times 10^{-5}$
185	34.1 ± 1.3	3.67×10^{16}	$(2.13 \pm 0.23) \times 10^{17}$	$(1.20 \pm 0.13) \times 10^{16}$	$(8.32 \pm 1.24) \times 10^{-5}$
187	39.8 ± 1.4	5.40×10^{16}	$(3.57 \pm 0.38) \times 10^{17}$	$(2.02 \pm 0.22) \times 10^{16}$	$(1.20 \pm 0.17) \times 10^{-4}$
190	36.3 ± 3.1	8.54×10^{16}	$(5.22 \pm 0.82) \times 10^{17}$	$(2.96 \pm 0.47) \times 10^{16}$	$(1.94 \pm 0.47) \times 10^{-4}$
190	41.5 ± 0.8	8.34×10^{16}	$(5.71 \pm 0.51) \times 10^{17}$	$(3.24 \pm 0.29) \times 10^{16}$	$(1.86 \pm 0.20) \times 10^{-4}$
193	37.2 ± 0.9	1.40×10^{17}	$(8.71 \pm 0.83) \times 10^{17}$	$(4.94 \pm 0.47) \times 10^{16}$	$(3.19 \pm 0.38) \times 10^{-4}$
195	25.2 ± 1.7	1.86×10^{17}	$(8.46 \pm 1.16) \times 10^{17}$	$(4.79 \pm 0.66) \times 10^{16}$	$(4.60 \pm 0.94) \times 10^{-4}$
197	25.1 ± 1.4	2.70×10^{17}	$(1.23 \pm 0.16) \times 10^{18}$	$(6.94 \pm 0.88) \times 10^{16}$	$(6.70 \pm 1.23) \times 10^{-4}$
200	22.5 ± 3.1	3.38×10^{17}	$(1.41 \pm 0.18) \times 10^{18}$	$(7.97 \pm 1.79) \times 10^{16}$	$(8.68 \pm 1.67) \times 10^{-4}$
200	20.3 ± 2.5	4.22×10^{17}	$(1.63 \pm 0.32) \times 10^{18}$	$(9.21 \pm 1.80) \times 10^{16}$	$(1.11 \pm 0.36) \times 10^{-3}$
205	16.3 ± 1.0	6.63×10^{17}	$(2.78 \pm 0.37) \times 10^{18}$	$(1.58 \pm 0.21) \times 10^{17}$	$(2.39 \pm 0.46) \times 10^{-3}$
209	11.6 ± 0.8	1.11×10^{18}	$(3.62 \pm 0.51) \times 10^{18}$	$(2.10 \pm 0.29) \times 10^{17}$	$(4.43 \pm 0.93) \times 10^{-3}$

*corrected for the molecular diffusion limitation (see text)

Table ESI-2: Condensation rate constant, k_c , evaporation rate J_{ev} and equilibrium vapor pressure P_{eq}

for B ice

Temperature (K)	$k_c^* (s^{-1})$	F_{ss} $\pm 5 \times 10^{13} (\text{molecule s}^{-1})$	$F_{cv} (\text{molecule s}^{-1})$	$J_{ev} (\text{molecule s}^{-1} \text{ cm}^{-2})$	$P_{eq} (\text{Torr})$
150	57.7 ± 2.4	5.66×10^{13}	$(3.81 \pm 3.80) \times 10^{14}$	$(2.16 \pm 2.15) \times 10^{13}$	$(7.94 \pm 8.22) \times 10^{-3}$
155	48.4 ± 3.5	1.35×10^{14}	$(7.96 \pm 4.09) \times 10^{14}$	$(4.51 \pm 2.32) \times 10^{13}$	$(2.01 \pm 1.18) \times 10^{-2}$
160	48.0 ± 4.5	2.88×10^{14}	$(1.71 \pm 0.58) \times 10^{15}$	$(9.68 \pm 3.28) \times 10^{13}$	$(4.41 \pm 1.91) \times 10^{-2}$
165	37.5 ± 4.7	7.48×10^{14}	$(3.68 \pm 0.96) \times 10^{15}$	$(2.08 \pm 0.55) \times 10^{14}$	$(1.23 \pm 0.48) \times 10^{-2}$
170	35.8 ± 4.6	2.39×10^{15}	$(1.15 \pm 0.25) \times 10^{16}$	$(6.50 \pm 1.43) \times 10^{14}$	$(4.09 \pm 1.43) \times 10^{-2}$
175	37.4 ± 3.0	4.98×10^{15}	$(2.50 \pm 0.40) \times 10^{16}$	$(1.41 \pm 0.23) \times 10^{15}$	$(8.66 \pm 2.10) \times 10^{-2}$
180	36.0 ± 2.2	1.49×10^{16}	$(7.35 \pm 0.99) \times 10^{16}$	$(4.16 \pm 0.57) \times 10^{15}$	$(2.68 \pm 0.53) \times 10^{-2}$
187	29.0 ± 4.4	5.30×10^{16}	$(2.24 \pm 0.50) \times 10^{17}$	$(1.27 \pm 0.28) \times 10^{16}$	$(1.04 \pm 0.39) \times 10^{-2}$
190	26.7 ± 3.3	8.17×10^{16}	$(3.26 \pm 0.64) \times 10^{17}$	$(1.85 \pm 0.36) \times 10^{16}$	$(1.65 \pm 0.53) \times 10^{-2}$
195	22.2 ± 3.7	1.74×10^{17}	$(6.12 \pm 1.46) \times 10^{17}$	$(3.47 \pm 0.83) \times 10^{16}$	$(3.77 \pm 1.53) \times 10^{-2}$
200	16.3 ± 4.1	3.72×10^{17}	$(1.20 \pm 0.34) \times 10^{18}$	$(6.78 \pm 1.93) \times 10^{16}$	$(8.59 \pm 4.27) \times 10^{-2}$
205	12.9 ± 1.8	6.73×10^{17}	$(1.68 \pm 0.35) \times 10^{18}$	$(9.53 \pm 1.97) \times 10^{16}$	$(1.83 \pm 0.63) \times 10^{-2}$

*corrected for the molecular diffusion limitation (see text)

Table ESI-3: SC ice large dose (5.0×10^{16} molecule/pulse), condensation rate constant, k_c , evaporation rate J_{ev} and equilibrium vapor pressure P_{eq}

Temperature (K)	$k_c^* (s^{-1})$	F_{ss} $\pm 5 \times 10^{13} \# s^{-1}$	$F_{cv} (\text{molecule s}^{-1})$	$J_{ev} (\text{molecule s}^{-1} \text{ cm}^{-2})$	$P_{eq} (\text{Torr})$
165	44.90 ± 2.12	7.68×10^{14}	$(5.63 \pm 1.03) \times 10^{15}$	$(3.19 \pm 0.58) \times 10^{14}$	$(1.58 \pm 0.36) \times 10^{-2}$
170	47.21 ± 3.50	2.07×10^{15}	$(1.59 \pm 0.27) \times 10^{16}$	$(8.98 \pm 1.52) \times 10^{14}$	$(4.29 \pm 1.04) \times 10^{-2}$
175	33.36 ± 4.48	4.06×10^{15}	$(2.31 \pm 0.50) \times 10^{16}$	$(1.31 \pm 0.29) \times 10^{15}$	$(8.99 \pm 3.16) \times 10^{-2}$
180	26.97 ± 3.19	1.53×10^{16}	$(7.35 \pm 1.41) \times 10^{16}$	$(4.16 \pm 0.80) \times 10^{15}$	$(3.58 \pm 1.11) \times 10^{-2}$
190	17.57 ± 3.88	6.51×10^{16}	$(2.26 \pm 0.66) \times 10^{17}$	$(1.28 \pm 0.38) \times 10^{16}$	$(1.74 \pm 0.89) \times 10^{-2}$
200	7.95 ± 2.27	2.81×10^{17}	$(5.96 \pm 2.12) \times 10^{17}$	$(3.38 \pm 1.20) \times 10^{16}$	$(1.04 \pm 0.67) \times 10^{-2}$

*corrected for molecular diffusion limitation (see text)

Table ESI-4: SC ice medium dose (9.0×10^{15} molecule/pulse), condensation rate constant, k_c ,evaporation rate J_{ev} and equilibrium vapor pressure P_{eq}

Temperature (K)	k_{eff}^* (s^{-1}) $\pm 5 \times 10^{13} \# s^{-1}$	F_{ss} $\pm 5 \times 10^{13} \# s^{-1}$	F_{ev} (molecule s^{-1})	J_{ev} (molecule $s^{-1} cm^{-2}$)	P_{eq} (Torr)
165	32.35 ± 2.71	7.48×10^{14}	$(4.16 \pm 0.92) \times 10^{15}$	$(2.36 \pm 0.52) \times 10^{14}$	$(1.62 \pm 0.49) \times 10^{-6}$
170	23.72 ± 1.90	2.07×10^{15}	$(9.00 \pm 1.57) \times 10^{15}$	$(5.10 \pm 0.89) \times 10^{14}$	$(4.84 \pm 1.24) \times 10^{-6}$
175	20.87 ± 1.21	4.06×10^{15}	$(1.60 \pm 0.23) \times 10^{16}$	$(9.06 \pm 1.28) \times 10^{14}$	$(9.93 \pm 1.97) \times 10^{-6}$
180	22.71 ± 1.37	1.53×10^{16}	$(6.43 \pm 0.86) \times 10^{16}$	$(3.64 \pm 0.49) \times 10^{15}$	$(3.72 \pm 0.72) \times 10^{-5}$
190	10.58 ± 2.05	6.51×10^{16}	$(1.62 \pm 0.43) \times 10^{17}$	$(9.19 \pm 2.44) \times 10^{15}$	$(2.07 \pm 0.95) \times 10^{-4}$

*corrected for molecular diffusion limitation (see text)

Table ESI-5: S ice, condensation rate constant, k_c , evaporation rate J_{ev} and equilibrium vapor pressure P_{eq} using a dose of 5.0×10^{16} molecule/pulse of H_2O

Temperature (K)	k_{eff}^* (s^{-1}) $\pm 5 \times 10^{13} \# s^{-1}$	F_{ss} $\pm 5 \times 10^{13} \# s^{-1}$	F_{ev} (molecule s^{-1})	J_{ev} (molecule $s^{-1} cm^{-2}$)	P_{eq} (Torr)
165	40.74 ± 5.33	8.76×10^{14}	$(5.91 \pm 1.53) \times 10^{15}$	$(3.35 \pm 0.86) \times 10^{14}$	$(1.82 \pm 0.71) \times 10^{-6}$
175	48.05 ± 4.20	5.89×10^{15}	$(4.58 \pm 0.67) \times 10^{16}$	$(2.59 \pm 0.43) \times 10^{15}$	$(1.23 \pm 0.31) \times 10^{-5}$
185	44.57 ± 5.86	3.18×10^{16}	$(2.32 \pm 0.71) \times 10^{17}$	$(1.31 \pm 0.27) \times 10^{16}$	$(6.93 \pm 2.32) \times 10^{-5}$
195	42.32 ± 3.98	1.86×10^{17}	$(1.30 \pm 0.21) \times 10^{18}$	$(7.34 \pm 1.21) \times 10^{16}$	$(4.19 \pm 1.08) \times 10^{-4}$
202	31.92 ± 4.40	4.75×10^{17}	$(2.61 \pm 0.54) \times 10^{18}$	$(1.48 \pm 0.31) \times 10^{17}$	$(1.69 \pm 0.59) \times 10^{-3}$

*corrected for the molecular diffusion limitation (see text)

Table ESI-6 : Compensated flow method (CFM) on B, ice condensation rate constant, k_c , evaporation rate J_{ev} and equilibrium vapor pressure P_{eq}

Temperature (K)	$F_{in} = F_{ss}$ $\pm 5 \times 10^{13} \# s^{-1}$	P_{eq} (Torr)	k_c^* (s^{-1})	F_{ev} (molecule s^{-1})	J_{ev} (molecule $s^{-1} cm^{-2}$)
Bulk ice data+					
170	2.10×10^{15}	$(3.78 \pm 0.36) \times 10^{-6}$	35.6 ± 4.2	$(1.05 \pm 0.18) \times 10^{16}$	$(5.97 \pm 0.70) \times 10^{14}$
180	1.20×10^{16}	$(2.22 \pm 0.17) \times 10^{-5}$	37.3 ± 3.7	$(6.30 \pm 0.83) \times 10^{16}$	$(3.57 \pm 0.35) \times 10^{15}$
190	7.80×10^{16}	$(1.48 \pm 0.11) \times 10^{-4}$	24.2 ± 2.7	$(2.65 \pm 0.37) \times 10^{17}$	$(1.51 \pm 0.17) \times 10^{16}$
200	4.10×10^{17}	$(8.00 \pm 0.56) \times 10^{-4}$	19.2 ± 3.6	$(1.11 \pm 0.18) \times 10^{18}$	$(6.28 \pm 0.85) \times 10^{16}$
210	2.20×10^{18}	$(4.40 \pm 0.31) \times 10^{-3}$	13.6 ± 2.5	$(4.21 \pm 0.89) \times 10^{18}$	$(2.39 \pm 0.44) \times 10^{17}$

*Corrected for the molecular diffusion limitation (see text)

+averaging over dose using the data on Figure ESI-1

Table ESI-7: TASSM on B ice, condensation rate constant, k_c , evaporation rate J_{ev} andequilibrium vapor pressure P_{eq}

Temperature (K)	$F_{ss}(L)$ ($\pm 5 \times 10^{13} \text{ # s}^{-1}$)	$F_{ss}(S)$ ($\pm 5 \times 10^{13} \text{ # s}^{-1}$)	F_{ev} (molecule s^{-1})	J_{ev} (molecule $\text{s}^{-1} \text{cm}^{-2}$)	$k_c (\text{s}^{-1})^*$	P_{eq} (Torr)
175	1.56×10^{15}	7.57×10^{14}	$(9.6 \pm 6.27) \times 10^{15}$	$(5.42 \pm 3.55) \times 10^{14}$	36.5 ± 32.1	$(3.40 \pm 5.23) \times 10^{-6}$
185	2.70×10^{16}	1.3×10^{16}	$(1.63 \pm 0.71) \times 10^{17}$	$(9.25 \pm 4.02) \times 10^{15}$	35.8 ± 15.9	$(6.07 \pm 5.34) \times 10^{-5}$
188	4.00×10^{16}	1.99×10^{16}	$(1.84 \pm 0.66) \times 10^{17}$	$(1.04 \pm 0.38) \times 10^{16}$	25.6 ± 9.4	$(9.67 \pm 7.01) \times 10^{-5}$
192	6.66×10^{16}	3.33×10^{16}	$(2.96 \pm 1.03) \times 10^{17}$	$(1.68 \pm 0.59) \times 10^{16}$	24.5 ± 8.6	$(1.64 \pm 1.15) \times 10^{-4}$
195	1.21×10^{17}	6.00×10^{16}	$(5.71 \pm 2.07) \times 10^{17}$	$(3.23 \pm 1.17) \times 10^{16}$	26.4 ± 9.6	$(2.96 \pm 2.15) \times 10^{-4}$
200	2.42×10^{17}	1.22×10^{17}	$(1.02 \pm 0.34) \times 10^{18}$	$(5.77 \pm 1.94) \times 10^{16}$	22.8 ± 7.7	$(6.20 \pm 4.17) \times 10^{-4}$
205	5.20×10^{17}	2.75×10^{17}	$(1.68 \pm 0.48) \times 10^{18}$	$(9.52 \pm 2.73) \times 10^{16}$	15.8 ± 4.6	$(1.49 \pm 0.85) \times 10^{-3}$

*corrected for molecular diffusion limitation (see text)

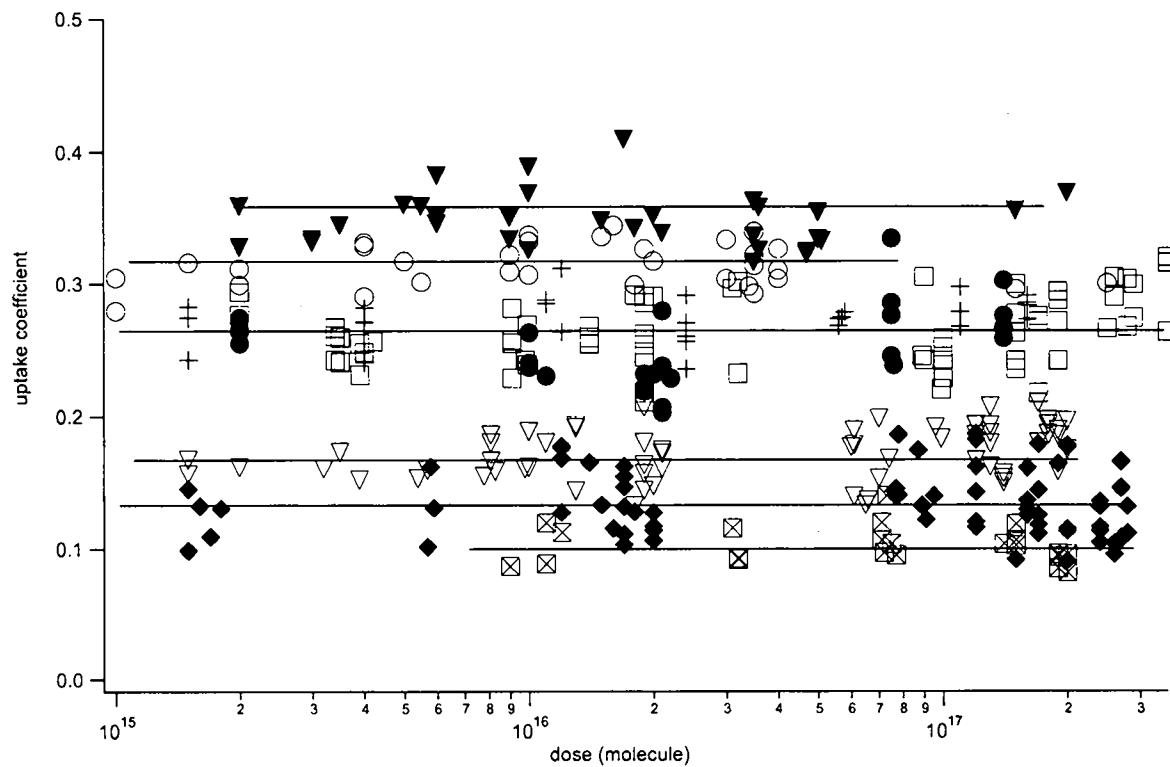
 $F_{ss}(L)$ and $F_{ss}(S)$ are the steady state flow by using the 14 and the 4 mm aperture, respectively.

Figure ESI-1: Uptake coefficient γ of $\text{H}_2\text{O(g)}$ on bulk (B) as a function of temperature and $\text{H}_2\text{O(g)}$ dose: (\blacktriangledown) 140 K, (\circ) 150 K, (+) 160 K, (\bullet) 170 K, (\square) 180 K, (∇) 190 K, (\blacklozenge) 200 K, (\blacksquare) 210 K.