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Equilibrium constants for hydrolysis and associated equilibria in critical compilations

Uranium(IV)

Equilibrium reactions	lg*K* at infinite dilution and *T* = 298 K			
	Baes and Mesmer, 1976	Thoenen et al., 2014	Brown and Ekberg, 2016	Grenthe et al., 2020
$U^{4+} + H_2O \rightleftharpoons UOH^{3+} + H^+$	–0.65	– 0.54 ± 0.06	–0.58 ± 0.08	–0.54 ± 0.06
$U^{4+} + 2\ H_2O \rightleftharpoons U(OH)_2^{2+} + 2\ H^+$	(–2.6)	–1.1 ± 1.0	–1.4 ± 0.2	–1.9 ± 0.2
$U^{4+} + 3\ H_2O \rightleftharpoons U(OH)_3^{+} + 3\ H^+$	(–5.8)	–4.7 ± 1.0	–5.1 ± 0.3	–5.2 ± 0.4
$U^{4+} + 4\ H_2O \rightleftharpoons U(OH)_4 + 4\ H^+$	(–10.3)	–10.0 ± 1.4	–10.4 ± 0.5	–10.0 ± 1.4
$U^{4+} + 5\ H_2O \rightleftharpoons U(OH)_5^{-} + 5\ H^+$	–16.0			
UO_2(am, hyd) + $4\ H^+ \rightleftharpoons U^{4+} + 2\ H_2O$		1.5 ± 1.0		
UO_2(am,hyd) + $2\ H_2O \rightleftharpoons U^{4+} + 4\ OH^-$			–54.500 ± 1.000	-54.500 ± 1.000
UO_2(c) + $4\ H^+ \rightleftharpoons U^{4+} + 2\ H_2O$	–1.8			
UO_2(c) + $2\ H_2O \rightleftharpoons U^{4+} + 4\ OH^-$				–60.860 ± 1.000

C.F. Baes and R.E. Mesmer, The Hydrolysis of Cations. Wiley, New York, 1976, p. 181.

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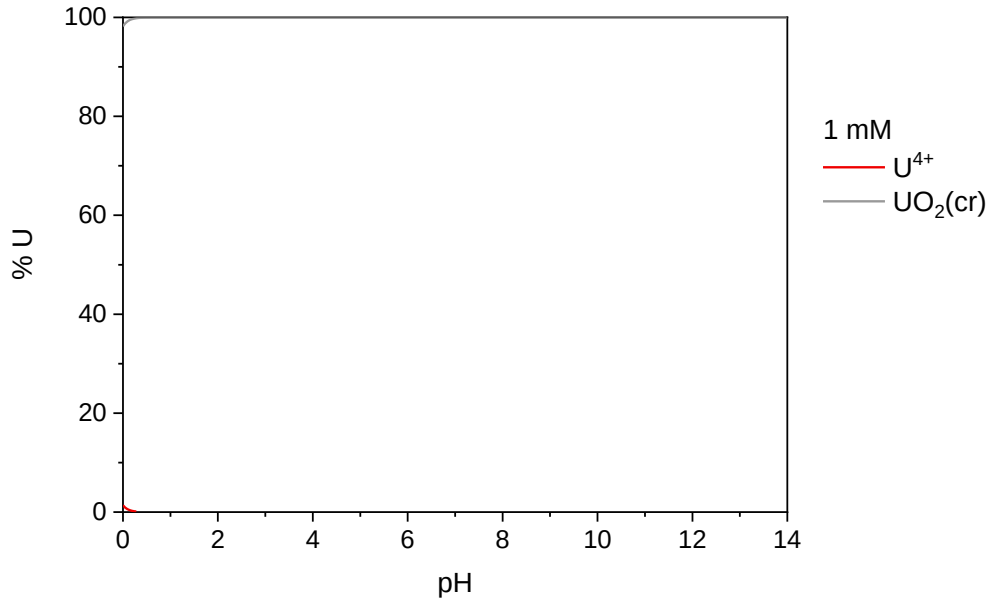
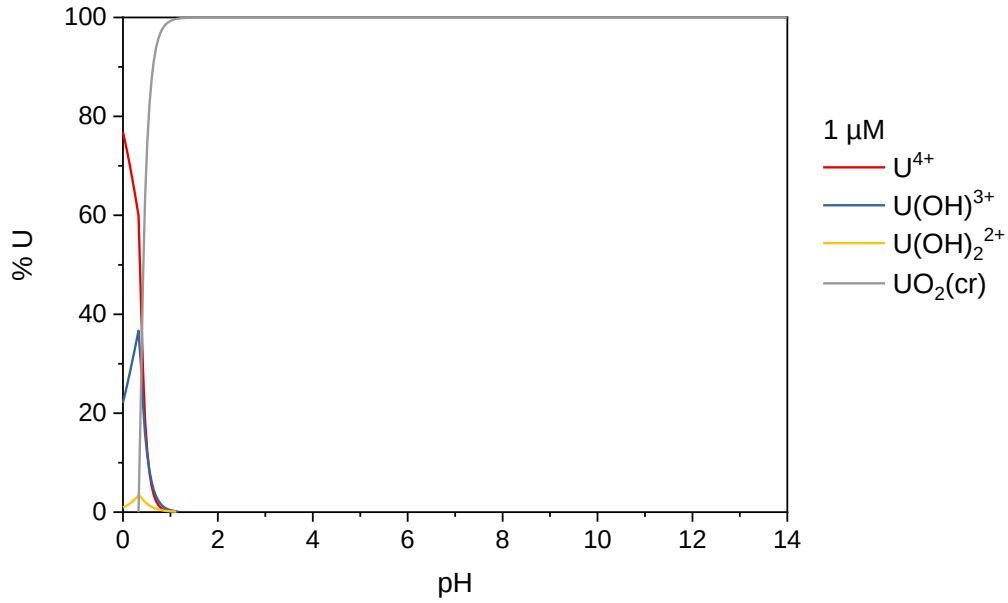
T. Thoenen, W. Hummel, U. Berner and E. Curti, The PSI/Nagra Chemical Thermodynamic Database 12/07, Villigen: Paul Scherrer Institut PSI, 2014.

Distribution diagrams

These diagrams have been computed at two U(IV) concentrations (1 mM = $1x10^{-3}$ mol L^{-1} and 1 µM = $1x10^{-6}$ mol L^{-1}) with the 'best' equilibrium constants above (in green). Calculations assume T = 298 K for the limiting case of zero ionic strength (*i.e.*, even neglecting plotted ions).





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Uranium(VI)

Equilibrium reactions	lg*K* at infinite dilution and *T* = 298 K				
	Baes and Mesmer, 1976	Grenthe et al., 1992	NIST46	Brown and Ekberg, 2016	Grenthe et al., 2020
$UO_2^{2+} + H_2O \rightleftharpoons UO_2(OH)^+ + H^+$	–5.8	–5.2 ± 0.3	–5.9 ± 0.1	–5.13 ± 0.04	$-5.2_5 \pm 0.2_4$
$UO_2^{2+} + 2\ H_2O \rightleftharpoons UO_2(OH)_2 + 2\ H^+$		≤ -10.3		$-12.1_5 \pm 0.2_0$	–12.15 ± 0.07
$UO_2^{2+} + 3\ H_2O \rightleftharpoons UO_2(OH)_3^- + 3\ H^+$		–19.2 ± 0.4		$-20.2_5 \pm 0.4_2$	$-20.2_5 \pm 0.4_2$
$UO_2^{2+} + 4\ H_2O \rightleftharpoons UO_2(OH)_4^{2-} + 4\ H^+$		–33 ± 2		$-32.4_0 \pm 0.6_8$	$-32.4_0 \pm 0.6_8$
$2\ UO_2^{2+} + 2\ H_2O \rightleftharpoons (UO_2)_2(OH)_2^{2+} + 2\ H^+$	–5.62	–5.62 ± 0.04	–5.58 ± 0.04	–5.68 ± 0.05	–5.62 ± 0.08
$3\ UO_2^{2+} + 5\ H_2O \rightleftharpoons (UO_2)_3(OH)_5^+ + 5\ H^+$	–15.63	$-15.5_5 \pm 0.1_2$	–15.6	$-15.7_5 \pm 0.1_2$	$-15.5_5 \pm 0.1_2$

$3\ UO_2^{2+} + 4\ H_2O \rightleftharpoons (UO_2)_3(OH)_4^{2+} + 4\ H^+$	(–11.75)	–11.9 ± 0.3		–11.78 ± 0.05	–11.9 ± 0.3
$3\ UO_2^{2+} + 7\ H_2O \rightleftharpoons (UO_2)_3(OH)_7^{-} + 7\ H^+$		–31 ± 2.0		–32.2 ± 0.8	–32.2± 0.8
$4\ UO_2^{2+} + 7\ H_2O \rightleftharpoons (UO_2)_4(OH)_7^{+} + 7\ H^+$		–21.9 ± 1.0		–22.1 ± 0.2	–21.9 ± 1.0
$2\ UO_2^{2+} + H_2O \rightleftharpoons (UO_2)_2(OH)^{3+} + H^+$		–2.7 ± 1.0			–2.7 ± 1.0
$UO_2(OH)_2(s) + 2H^+ \rightleftharpoons UO_2^{2+} + 2\ H_2O$	5.6		6.0	4.81 ± 0.20	
$UO_3{\cdot}2H_2O(cr) + 2H^+ \rightleftharpoons UO_2^{2+} + 3\ H_2O$					5.350 ± 0.130

C.F. Baes and R.E. Mesmer, The Hydrolysis of Cations. Wiley, New York, 1976, p. 182.

P.L. Brown and C. Ekberg, Hydrolysis of Metal Ions. Wiley, 2016, pp. 350–379.

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I. Grenthe, X. Gaona, A.V. Plyasunov, L. Rao, W.H. Runde, B. Grambow, R.J.M. Konings, A.L. Smith and E.E. Moore, Second Update on the Chemical Thermodynamics of Uranium, Neptunium, Plutonium, Americium and Technetium, OECD Publishing, Paris, 2020.

NIST46, NIST Critically Selected Stability Constants of Metal Complexes: Version 8.0. Available at: www.nist.gov/srd/nist46

Distribution diagrams

These diagrams have been computed at two U(VI) concentrations (1 mM = $1x10^{-3}$ mol L^{-1} and 1 µM = $1x10^{-6}$ mol L^{-1}) with the 'best' equilibrium constants above (in green). Calculations assume T = 298 K for the limiting case of zero ionic strength (*i.e.*, even neglecting plotted ions).