THORIUM

Th^0 5f° | 6d: ↓ ↓ | 7s: ↓↑ | 7p: | **EN** 1.1

2 + (d^2) **3 + (d^1)** **4 + (d^0)**

Th, met., silver-wh., pliant, $d = 11.7$, m.p. 1750, b.p. 4200, tarnish in air; powd. pyrophoric sol. in (conc. HCl + F$^-$), aq. regia, passiv. conc. HNO_3, $E_0Th^{4+}/Th_{sld} = -1.87$, α-, cub. cl. pack $a = 5.08$, Th—Th 3.59 ↓ 1365° β-, α-Fe str. type, $a = 4.11$

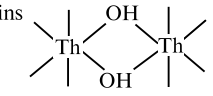
O_2; Ca (Ar, 1100°); H_2O (steam)

ThO_2, powd., wh., $d = 9.87$, m.p. 3220, b.p. 4400, sol. in conc. H_2SO_4 (*t*), (HF + HNO_3), bright light in flame (in the presence 1% Ce_2O_3), $\Delta H = -1225$, CaF_2 str. type (CN Th 8), "thorianite" (+ UO_2)

$Th(C_2O_4)_2$ —600°, (−CO_2−CO)→ **ThO_2**

t

$Th(OH)_4$↓, gel wh., SP = 10^{-35}, sol. in ac., M_2CO_3 (unlike La $(OH)_3$↓), absorb, CO_2, peptizate alk., in str. — chains



NH_4OH; $(NH_4)_2S$; M_2CO_3

$Th_2O_7 \cdot 4H_2O$ [13] = $2ThO_2 \cdot 3H_2O_2 \cdot H_2O$
$Th(O_2)^{2-}_{1.6}O_{0.15}X_{0.5} \cdot nH_2O$

$[Th(HSO_4)(SO_4)]^+$ [8]

$[ThCl_n]^{(4-n)+}$; $[Th(NO_3)]^{3+}$

aq. regia; $H^+ + F^-$

$[ThF_n(H_2O)_m]^{(n-4)-}$

F^- ↑↓

$[Th(H_2O)_n]^{4+}$

Th — $HClO_4$ ↑↓ H_2O (pH > 3)

$[Th(OH)_n(H_2O)_m]^{(4-n)+}$, $n = 1-3$

H^+ ↑↓ H_2O

$[Th_2(OH)_6(H_2O)_n]^{2+}$ ...

H^+ ↑↓ OH^-

$[Th_6(OH)_{15}(H_2O)_n]^{9+}$ ↓ **$[Th_4(OH)_{12}]^{4+}$** in polymeric ions — OH-br.

H^+ ↑↓ OH^-

$Th(OH)_4$↓, wh.

S; H_2S; H_2; N_2

cath. Red: Ca; Ba; Mg; *t*

Th Hal_4

ThS; Th_2S_3; Th_4S_7; ThS_2
Th_2S_5, CN Th 10 [9]
Th_3N_4, ("Th_2N_3"), **ThN**
Th_2N_2O
ThC, **ThC_2**, + $H_2O \longrightarrow CH_4 + C_nH_{2n} + \ldots$
ThSi; **$ThSi_2$**; **Th_3Si_2**
ThB_4, **ThB_6**
ThH_2, **Th_4H_{15}**

$Th(IO_3)_4$↓, insol. in 50% HNO_3 [unlike $Ln(IO_3)_3$]
$Th(OH)_2SO_4$ [10]
$Th(SO_4)_2$, colrl., hyg., $\cdot nH_2O$, n = 2, 4, 6, 8, 9, in str. — $[Th_6O_4(OH)_4]^{12+}$
$Th(OH)_2CrO_4 \cdot H_2O$
$Th(NO_3)_4$, $\xleftarrow{N_2O_5}$ $\cdot 5H_2O$, in s. hydr. readily sol. in alc. R_2O, acet. (unlike $Ln(NO_3)_3$), in str. — $[ThO_8(H_2O)_3]$
$Th(PO_3)_4$↓, cr., from melt., hydr., sol. in ac.; **(Zn, Th)PO_4**, "monazite"
$Th(HAsO_4)_2 \cdot nH_2O$, n = 1–4 [11]
$ThO(CO_3) \cdot 8H_2O$↓
$Th(HCOO)_4$ [5]; **$[Th(HCOO)_4(H_2O)_2] \cdot H_2O$**, CN Th 10
$Th(C_2O_4)_2 \cdot 6H_2O$↓, insol. in ac. (unlike Zr)
$ThSiO_4$, "orangite", "thorite" (blk.)

$K[Th_4(IO_3)_{17}] \cdot 18H_2O$↓ [6]
$H_2[Th_2(SO_4)_5] \cdot 2H_2O$; **$M_8[Th(SO_4)_6]$**
$M_2[Th(SO_4)_3]$, $\cdot nH_2O$, CN Th 9
$M_4[Th(SO_4)_4] \cdot 2H_2O$, CN Th 9 (trig. prism. with centered faces)
$M[Th(NO_3)_5]$; **$M_2[Th(NO_3)_6]$**, M = M^I, H
$Mg[Th(NO_3)_6] \cdot 8H_2O$, CN Th 12 (icosah.)

$Na_6[Th(CO_3)_5] \cdot 12H_2O$, CN Th 10; [6]
$M_2Th(CO_3)_3 \cdot nH_2O$; **$Na_4Th(CO_3)_4 \cdot 7H_2O$**
$(NH_4)_2[Th_2(C_2O_4)_5]$↓
$M_4[Th(C_2O_4)_4]$, M = K, NH_4, anion — twocap square antiprism [7]

$Th(O_2)SO_4 \cdot 3H_2O$
$H_2[Th(O_2)(SO_4)_2]$

ThOHal$_2$, Hal = F – I, in str. — chains Th—O—Th—

3, 4)	m.p.	b.p.	ΔH	$\cdot nH_2O$, n =
ThF_4↓, SP = 10^{-26}, insol. in ac.	1100	1680	−2096	1/6, 2, 4
$ThCl_4$, colrl.	770	922	−1192	2–12, **8**
$ThBr_4$, »	678 [4]	880	−1012	4, 7, 8, 10, 12
ThI_4, yel.	566	837	−673	10

In str. ThF_4 (ZrF_4 str. type) — antiprism $[MF_8]$; $ThCl_4$, $ThBr_4$ (UCl_4 str. type) — 2 crossing tetrah. (CN = 4 + 4).
$ThF_4 \cdot 1/6\,H_2O$, trig. twocap. prism and tetr. antiprism

$ThCl_2$ (?) [1]
$ThBr_2$
ThI_2 = $Th^{4+}(I^-)_2e_2$ (?), cr. golden, conduct., m.p. 566, CdI_2 str. type, 880° ⟶ Th + ThI_4↑

$ThCl_3$ (?) [1]
$ThBr_3$
ThI_3, α-, β-, CN Th 8 (cube and square antiprism), Th—Th 3.46

Th

K_5ThF_9 (CN Th 8) [2]
Na_4ThF_8; **M_3ThF_7**, CN Th 9 (tetr. single-cap prism)
Th—F 2.36–2.40
M_2ThF_6; **$MThF_5$**; **$RbTh_3F_{13}$**
M_2ThCl_6; **$[PyH]_2[ThCl_6]$**
M_2ThBr_6
K_2ThI_6; **Li_3ThI_7**, in str. — tetr. single-cap. prism $[ThI_9]$

$[R_4N]_4[Th(NCS)_8]$, anion — cube [14]

$(NH_4)_3[ThF_5(O_2)]$

$Th(CH_3COCHCOCH_3)_4$, subl. 160; in mol. — dodecah. $[ThO_8]$ [12]
$Th(BH_4)_4$, sol. in Et_2O, m.p. 204, subl. 40 (vac.)

Th — HCl conc. (output 25 %) → **$H_{1.3}ThO_{1.3}Cl_{0.7}$**↓, (before "ThO"), blk.

Use of Th:

$^{232}_{90}Th\ (n, \gamma)\ ^{233}_{90}Th \xrightarrow{\beta^-} {}^{233}_{91}Pa \xrightarrow{\beta^-} {}^{233}_{92}U$ nuclear fuel

N. Turova, *Inorganic Chemistry in Tables*, DOI 10.1007/978-3-642-20487-6_22, © Springer-Verlag Berlin Heidelberg 2011