Greenwood & Earnshaw

2nd Edition

Chapter 16

Selenium, Tellurium & Polonium

Selenium, Tellurium, Polonium

Selenium

$^{74}_{34}Se$ 0.87% $^{76}_{34}Se$ 9.02% $^{77}_{34}Se$ 7.58% I = 1/2

$^{78}_{34}Se$ 23.52% $^{80}_{34}Se$ 49.82% $^{82}_{34}Se$ 9.19% $t_{½} = 1.4 \times 10^{20}$ y

Tellurium

$^{120}_{52}Te$ 0.089% $^{122}_{52}Te$ 2.46% $^{123}_{52}Te$ 0.87% I = 1/2 $^{124}_{52}Te$ 4.61%

$^{125}_{52}Te$ 6.99% $^{126}_{52}Te$ 18.71% $^{128}_{52}Te$ 31.79% $^{130}_{52}Te$ 34.48% I = 1/2

Polonium

$^{208}_{84}Po$ $t_{½}$ = 2.90y $^{209}_{84}Po$ $t_{½}$ = 102y $^{210}_{84}Po$ $t_{½}$ = 138d

Allotropes: **6**

3 Se_8 nonmetallic, nonconducting.

1 hexagonal,"metallic", a photoconductor, most stable. Xerox.

1 Se_x amorphous, "red".

1 vitreous, glassy, black, brittle.

1

1 hexagonal,"metallic", a semiconductor.

2

1 cubic, α ,"metallic", a conductor. ↓35°C

1 rhombohedral, β , "metallic",conductor.

Questions:

1 Why so many isotopes?

2 Why do abundances peak where they do?

Selenium, Tellurium, Polonium

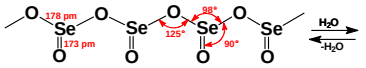
Trends:

Stability of E=C bonds decreases down group.

O=C=O	S=C=S	Se=C=Se	Se=C=Te	Te=C=Te
stable	stable	polymerizes readily	unstable	unknown

Stability of E=O bonds decreases down group.

SO_2	SeO_2	TeO_2	PoO_2
gas	CN = 3, chain polymer	CN = 4, double chain polymer; CN = 6, rutile str	"Fluorite" CaF_2 structure.



$\xrightarrow[-H_2O]{H_2O}$ H_2SeO_3 $K_{a1} = 3.5 \times 10^{-3}$ $K_{a2} = 5 \times 10^{-8}$

Structure is a corner linked set of flattened pyramids.

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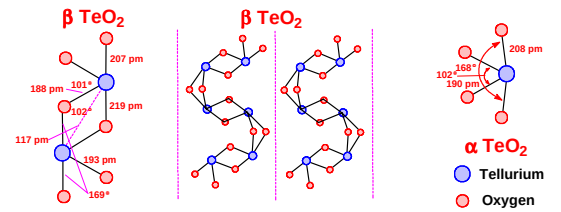


Pseudotrigonal bypyramids aggregate into layers.

The nearly identical tbp of α TeO_2 has all oxygen atoms shared in a rutile structure.

$\angle_{Te\text{-}O\text{-}Te} = 140°$

$$TeO_2 + H_2O \rightleftharpoons H_2TeO_3$$

$K_{a1} = 3.0 \times 10^{-3}$

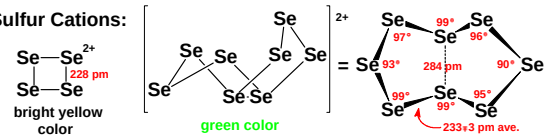
$K_{a2} = 2 \times 10^{-8}$

Selenium & Tellurium Cations

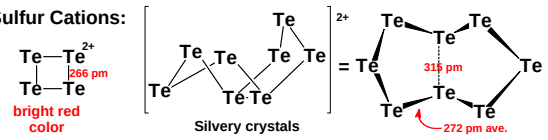
$Se_8 + SO_3\ (H_2SO_4) \longrightarrow$ Colored Solutions; Te is similar.

$$Se_8 + 3\ AsF_5 \xrightarrow{SO_{2(l)}} Se_8^{2+} + 2\ AsF_6^- + AsF_3$$

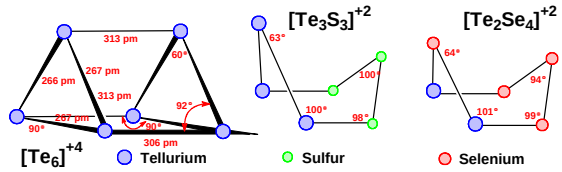
Sulfur Cations:

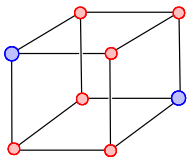


Sulfur Cations:

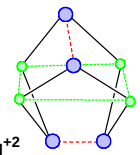


Other Selenium & Tellurium Cations





$[Te_2Se_6]^{+2}$

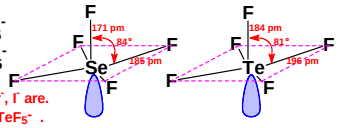


$[Te_4S_4]^{+2}$

Fluorides of Se & Te

$SeF_4 + F^- \longrightarrow SeF_5^-$

$TeF_4 + F^- \longrightarrow TeF_5^-$



No MF_6^{-2} are known but Cl^-, Br^-, I^- are.
SeF_5^- is much less stable than TeF_5^- .

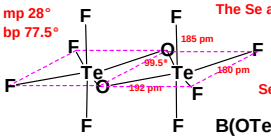
$Me_4N^+F^- + TeF_6 \longrightarrow TeF_7^-$ and TeF_8^{-2}

pentagonal bipyramid — square antiprism

OMF_4 M = Se, Te are dimers.

mp 28°
bp 77.5°

The Se analogue is much more reactive.



$\xrightarrow{F^-}$ $[OTeF_5]^-$ "teflate"

Se is similar.

H^+ → $HOTeF_5$ "teflic" acid

A very electro-negative group.

$B(OTeF_5)_3 + XeF_4 \longrightarrow Xe(OTeF_5)_4$

Boron transfers by bridging intermediates.