Tellurium

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Tellurium is a chemical element with symbol **Te** and atomic number 52. It is a brittle, mildly toxic, rare, silver-white metalloid. Tellurium is chemically related to selenium and sulfur. It is occasionally found in native form as elemental crystals. Tellurium is far more common in the universe as a whole than on Earth. Its extreme rarity in the Earth's crust, comparable to that of platinum, is due partly to its high atomic number, but also to its formation of a volatile hydride which caused it to be lost to space as a gas during the hot nebular formation of the planet.

Tellurium was discovered in the Habsburg Empire, in 1782 by Franz-Joseph Müller von Reichenstein in a mineral containing tellurium and gold. Martin Heinrich Klaproth named the new element in 1798 after the Latin word for "earth", *tellus*. Gold telluride minerals are the most notable natural gold compounds. However, they are not a commercially significant source of tellurium itself, which is normally extracted as a by-product of copper and lead production.

Commercially, the primary use of tellurium is copper and steel alloys, where it improves machinability. Applications in CdTe solar panels and semiconductors also consume a considerable portion of tellurium production.

Tellurium has no biological function, although fungi can use it in place of sulfur and selenium in amino acids such as tellurocysteine and telluromethionine.[5] In humans, tellurium is partly metabolized into dimethyl telluride, $(CH_3)_2Te$, a gas with a garlic-like odor exhaled in the breath of victims of tellurium exposure or poisoning.

Tellurium, $_{52}$Te

General properties	
Name, symbol	tellurium, Te
Appearance	silvery lustrous gray (crystalline), brown-black powder (amorphous)

Tellurium in the periodic table	
Atomic number (*Z*)	52
Group, block	group 16 (chalcogens), p-block
Period	period 5
Element category	□ metalloid
Standard atomic weight (±) (A_r)	127.60(3)[1]
Electron configuration	[Kr] $4d^{10}\ 5s^2\ 5p^4$

Characteristics

Physical properties

Tellurium has two allotropes, crystalline and amorphous. When crystalline, tellurium is silvery-white with a metallic luster. It is a brittle and easily pulverized metalloid. Amorphous tellurium is a black-brown powder prepared by precipitating it from a solution of tellurous acid or telluric acid $(Te(OH)_6)$.[6] Tellurium is a semiconductor that shows a greater electrical conductivity in certain directions depending on atomic alignment; the conductivity increases slightly when exposed to light (photoconductivity).[7] When molten, tellurium is corrosive to copper, iron, and stainless steel. Of the chalcogens, tellurium has the highest melting and boiling points, at 722.66 K (841.12 °F) and 1,261 K (1,810 °F), respectively.[8]

Chemical properties

Tellurium adopts a polymeric structure consisting of zig-zag chains of Te atoms. This gray material resists oxidation by air and is not volatile.

Isotopes

Naturally occurring tellurium has eight isotopes. Six of those isotopes, ^{120}Te, ^{122}Te, ^{123}Te, ^{124}Te, ^{125}Te and ^{126}Te, are stable. The other two, ^{128}Te and ^{130}Te, have been found to be slightly radioactive,[9][10][11] with extremely long half-lives, including 2.2×10^{24} years for ^{128}Te. This is the longest known half life among all radionuclides[12] and is approximately 160 trillion (10^{12}) times the age of the known universe. Stable isotopes comprise only 33.2% of naturally occurring tellurium.

A further thirty artificial radioisotopes of tellurium are known with atomic masses ranging from 105 to 142 and with half lives of 19 days or less. There are also 17 nuclear isomers, with half lives of up to 154 days. Tellurium (^{106}Te to ^{110}Te) is among the lightest elements known to undergo alpha decay.[9]

The atomic mass of tellurium (127.60 g·mol^{-1}) exceeds that of iodine (126.90 g·mol^{-1}), the next element in the periodic table.[13]

Occurrence

With an abundance in the Earth's crust comparable to that of platinum (about 1 µg/kg), tellurium is one of the rarest stable solid elements.[14] In comparison, even the rarest of the lanthanides have crustal abundances of 500 µg/kg (see Abundance of the chemical elements).[15]

per shell	2, 8, 18, 18, 6

Physical properties

Phase	solid
Melting point	722.66 K (449.51 °C, 841.12 °F)
Boiling point	1261 K (988 °C, 1810 °F)
Density near r.t.	6.24 g/cm^3
when liquid, at m.p.	5.70 g/cm^3
Heat of fusion	17.49 kJ/mol
Heat of vaporization	114.1 kJ/mol
Molar heat capacity	25.73 J/(mol·K)

Vapor pressure

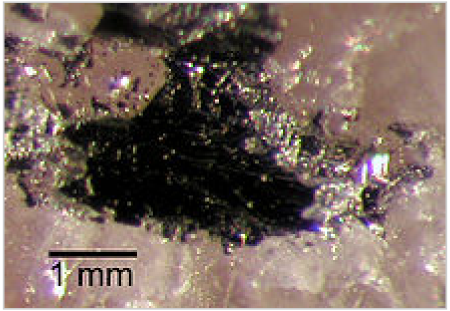
P (Pa)	**1**	**10**	**100**	**1 k**	**10 k**	**100 k**
at T (K)			(775)	(888)	1042	1266

Atomic properties

Oxidation states	**6**, 5, **4**, 3, **2**, 1, −1, **−2** (a mildly acidic oxide)
Electronegativity	Pauling scale: 2.1
Ionization energies	1st: 869.3 kJ/mol 2nd: 1790 kJ/mol 3rd: 2698 kJ/mol
Atomic radius	empirical: 140 pm
Covalent radius	138±4 pm
Van der Waals radius	206 pm

Miscellanea

Crystal structure	hexagonal



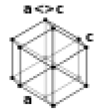
Tellurium on quartz (Moctezuma, Sonora, Mexico)


Native tellurium crystal on sylvanite (Vatukoula, Viti Levu, Fiji). Picture width 2 mm.

This rarity of tellurium in the Earth's crust is not a reflection of its cosmic abundance. Tellurium is more abundant than rubidium in the cosmos, though rubidium is ten thousand times more abundant in the Earth's crust. The rarity of tellurium on Earth is thought to be caused by conditions during the formation of the Earth, when the stable form of certain elements, in the absence of oxygen and water, was controlled by the reductive power of free hydrogen. Under this scenario, certain elements that form volatile hydrides, such as tellurium, were severely depleted through evaporation of these hydrides. Tellurium and selenium are the heavy elements most depleted by this process.

Tellurium is sometimes found in its native (i.e., elemental) form, but is more often found as the tellurides of gold such as calaverite and krennerite (two different polymorphs of $AuTe_2$), petzite, Ag_3AuTe_2, and sylvanite, $AgAuTe_4$. The city of Telluride, Colorado was named in hope of a strike of gold telluride (which never materialized, though gold metal ore was found). Gold itself is usually found uncombined, but when found as a chemical compound, it is most often combined with tellurium.

Although tellurium is found with gold more often than in uncombined form, it is found even more often combined as tellurides of more common metals (e.g. melonite, $NiTe_2$). Natural tellurite and tellurate minerals also occur, formed by oxidation of tellurides near the Earth's surface. In contrast to selenium, tellurium does not usually replace sulfur in minerals because of the great difference in ion radii. Thus, many common sulfide minerals contain substantial quantities of selenium and only traces of tellurium.[16]



Speed of sound thin rod	2610 m/s (at 20 °C)
Thermal expansion	18 µm/(m·K)[2] (at r.t.)
Thermal conductivity	1.97–3.38 W/(m·K)
Magnetic ordering	diamagnetic[3]
Young's modulus	43 GPa
Shear modulus	16 GPa
Bulk modulus	65 GPa
Mohs hardness	2.25
Brinell hardness	180–270 MPa
CAS Number	13494-80-9
History	
Naming	after Roman *Tellus*, deity of the Earth
Discovery	Franz-Joseph Müller von Reichenstein (1782)
First isolation	Martin Heinrich Klaproth

Most stable isotopes of tellurium

In the gold rush of 1893, miners in Kalgoorlie discarded a pyritic material as they searched for pure gold, and it was used to fill in potholes and build sidewalks. In 1896, that tailing was discovered to be calaverite, a telluride of gold, and it sparked a second gold rush that included mining the streets.[17]

iso	NA	half-life	DM	DE (MeV)	DP
^{120}Te	0.09%	is stable with 68 neutrons			
^{121}Te	syn	16.78 d	ε	1.040	^{121}Sb
^{122}Te	2.55%	is stable with 70 neutrons			
^{123}Te	0.89%[4]	is stable with 71 neutrons			
^{124}Te	4.74%	is stable with 72 neutrons			
^{125}Te	7.07%	is stable with 73 neutrons			
^{126}Te	18.84%	is stable with 74 neutrons			
^{127}Te	syn	9.35 h	β^-	0.698	^{127}I
^{128}Te	31.74%	2.2×10^{24} y	$\beta^-\beta^-$	0.867	^{128}Xe
^{129}Te	syn	69.6 min	β^-	1.498	^{129}I
^{130}Te	34.08%	7.9×10^{20} y	$\beta^-\beta^-$	2.528	^{130}Xe

Source

- Wikipedia: Tellurium (https://en.wikipedia.org/wiki/Tellurium)