Strontium

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Strontium is a chemical element with symbol **Sr** and atomic number 38. An alkaline earth metal, strontium is a soft silver-white or yellowish metallic element that is highly reactive chemically. The metal forms a dark oxide layer when it is exposed to air. Strontium has physical and chemical properties similar to those of its two vertical neighbors in the periodic table, calcium and barium. It occurs naturally in the minerals celestine, strontianite, and putnisite, and is mined mostly from the first two of these. While natural strontium is stable, the synthetic ^{90}Sr isotope is radioactive and is one of the most dangerous components of nuclear fallout, as strontium is absorbed by the body in a similar manner to calcium. Natural stable strontium, on the other hand, is not hazardous to health.

Both strontium and strontianite are named after Strontian, a village in Scotland near which the mineral was discovered in 1790 by Adair Crawford and William Cruickshank; it was identified as a new element the next year from its crimson-red flame test color. Strontium was first isolated as a metal in 1808 by Humphry Davy using the then-newly discovered process of electrolysis. The production of sugar from sugar beet was in the 19th century the largest application of strontium (see strontian process). At the peak of production of television cathode ray tubes, as much as 75 percent of strontium consumption in the United States was used for the faceplate glass.[4] With the displacement of cathode ray tubes by other display methods, consumption of strontium has dramatically declined.[4]

Strontium, $_{38}$Sr

General properties	
Name, symbol	strontium, Sr
Appearance	silvery white metallic; with a pale yellow tint[1]
Strontium in the periodic table	
Atomic number (*Z*)	38
Group, block	group 2 (alkaline earth metals), s-block
Period	period 5
Element category	alkaline earth metal
Standard atomic weight (±) (A_r)	87.62(1)[2]
Electron configuration	[Kr] $5s^2$
per shell	2, 8, 18, 8, 2
Physical properties	
Phase	solid
Melting point	1050 K (777 °C, 1431 °F)
Boiling point	1650 K (1377 °C, 2511 °F)

Characteristics

Strontium is a divalent silvery metal with a pale yellow tint whose properties are mostly intermediate between and similar to those of its group neighbors calcium and barium.[5] It is softer than calcium and harder than barium. Its melting (777 °C) and boiling (1655 °C) points are lower than those of calcium (842 °C and 1757 °C respectively); barium continues this downward trend in the melting point (727 °C), but not in the boiling point (2170 °C). The density

Oxidized dendritic strontium

of strontium (2.64 g/cm^3) is similarly intermediate between those of calcium (1.54 g/cm^3) and barium (3.594 g/cm^3).[6] Three allotropes of metallic strontium exist, with transition points at 235 and 540 °C.[7]

The standard electrode potential for the Sr^{2+}/Sr couple is −2.89 V, approximately midway between those of the Ca^{2+}/Ca (−2.84 V) and Ba^{2+}/Ba (−2.92 V) couples, and close to those of the neighboring alkali metals.[8] Strontium is intermediate between calcium and barium in its reactivity toward water, with which it reacts on contact to produce strontium hydroxide and hydrogen gas. Strontium metal burns in air to produce both strontium oxide and strontium nitride, but since it does not react with nitrogen below 380 °C, at room temperature, it forms only the oxide spontaneously.[6] Besides the simple oxide SrO, the peroxide SrO_2 can be made by direct oxidation of strontium metal under a high pressure of oxygen, and there is some evidence for a yellow superoxide $Sr(O_2)_2$.[9] Strontium hydroxide, $Sr(OH)_2$, is a strong base, though it is not as strong as the hydroxides of barium or the alkali metals.[10]

Due to the large size of the heavy s-block elements, including strontium, a vast range of coordination numbers is known, from 2, 3, or 4 all the way to 22 or 24 in $SrCd_{11}$ and $SrZn_{13}$.[11] The large size of strontium and barium plays a significant part in stabilising strontium complexes with polydentate macrocyclic ligands such as crown ethers: for example, while 18-crown-6 forms relatively weak complexes with calcium and the alkali metals, its strontium and barium complexes are much stronger.[12]

Density near r.t.	2.64 g/cm^3
when liquid, at m.p.	2.375 g/cm^3
Heat of fusion	7.43 kJ/mol
Heat of vaporization	141 kJ/mol
Molar heat capacity	26.4 J/(mol·K)

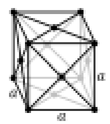
Vapor pressure

P (Pa)	**1**	**10**	**100**	**1 k**	**10 k**	**100 k**
at T (K)	796	882	990	1139	1345	1646

Atomic properties

Oxidation states	**2**, 1[3] (a strongly basic oxide)
Electronegativity	Pauling scale: 0.95
Ionization energies	1st: 549.5 kJ/mol 2nd: 1064.2 kJ/mol 3rd: 4138 kJ/mol
Atomic radius	empirical: 215 pm
Covalent radius	195±10 pm
Van der Waals radius	249 pm

Miscellanea

Crystal structure	face-centered cubic (fcc) 
Thermal expansion	22.5 µm/(m·K) (at 25 °C)
Thermal conductivity	35.4 W/(m·K)
Electrical resistivity	132 nΩ·m (at 20 °C)
Magnetic ordering	paramagnetic

Organostrontium compounds contain one or more strontium–carbon bonds. They have been reported as intermediates in Barbier-type reactions.[13][14][15] Although strontium is in the same group as magnesium, and organomagnesium compounds are very commonly used throughout chemistry, organostrontium compounds are not similarly widespread because they are more difficult to make and more reactive. Organostrontium compounds tend to be more similar to organoeuropium or organosamarium compounds due to the similar ionic radii of these elements (Sr^{2+} 118 pm; Eu^{2+} 117 pm; Sm^{2+} 122 pm). Most of these compounds can only be prepared at low temperatures; bulky ligands tend to favor stability. For example, strontium dicyclopentadienyl, $Sr(C_5H_5)_2$, must be made by directly reacting strontium metal with mercurocene or cyclopentadiene itself; replacing the C_5H_5 ligand with the bulkier $C_5(CH_3)_5$ ligand on the other hand increases the compound's solubility, volatility, and kinetic stability.[16]

Because of its extreme reactivity with oxygen and water, this element occurs naturally only in compounds with other elements, such as in the minerals strontianite and celestine. It is kept under a liquid hydrocarbon such as mineral oil or kerosene to prevent oxidation; freshly exposed strontium metal rapidly turns a yellowish color with the formation of the oxide. Finely powdered strontium metal is pyrophoric, meaning that it will ignite spontaneously in air at room temperature. Volatile strontium salts impart a bright red color to flames, and these salts are used in pyrotechnics and in the production of flares.[6] Like calcium and barium, strontium metal dissolves directly in liquid ammonia to give a dark blue solution.[5]

Young's modulus	15.7 GPa
Shear modulus	6.03 GPa
Poisson ratio	0.28
Mohs hardness	1.5
CAS Number	7440-24-6
History	
Naming	after the mineral strontianite, itself named after Strontian, Scotland
Discovery	William Cruickshank (1787)
First isolation	Humphry Davy (1808)

Most stable isotopes of strontium

iso	NA	half-life	DM	DE (MeV)	DP
^{82}Sr	syn	25.36 d	ε	–	^{82}Rb
^{83}Sr	syn	1.35 d	ε	–	^{83}Rb
			β+	1.23	^{83}Rb
			γ	0.76, 0.36	–
^{84}Sr	0.56%	is stable with 46 neutrons			
^{85}Sr	syn	64.84 d	ε	–	^{85}Rb
			γ	0.514D	–
^{86}Sr	9.86%	is stable with 48 neutrons			
^{87}Sr	7.00%	is stable with 49 neutrons			
^{88}Sr	82.58%	is stable with 50 neutrons			
^{89}Sr	syn	50.52 d	ε	1.49	^{89}Rb
			β−	0.909D	^{89}Y
^{90}Sr	trace	28.90 y	β−	0.546	^{90}Y

Isotopes

Natural strontium is a mixture of four stable isotopes: ^{84}Sr, ^{86}Sr, ^{87}Sr, and ^{88}Sr.[6] Their abundance increases with increasing mass number and the heaviest, ^{88}Sr, makes up about 82.6% of all natural strontium, though the abundance varies due to the production of radiogenic ^{87}Sr as the daughter of beta-active ^{87}Rb.[17] Of the unstable isotopes, the primary decay mode of the isotopes lighter than ^{85}Sr is electron capture or positron emission to isotopes of rubidium, and that of the isotopes heavier than

^{88}Sr is electron emission to isotopes of yttrium. Of special note are ^{89}Sr and ^{90}Sr. The former has a half-life of 50.6 days and is used to treat bone cancer due to strontium's chemical similarity and hence ability to replace calcium.[18][19] While ^{90}Sr (half-life 28.90 years) has been used similarly, it is also an isotope of concern in fallout from nuclear weapons and nuclear accidents due to its production as a fission product. Its presence in bones can cause bone cancer, cancer of nearby tissues, and leukemia.[20] The 1986 Chernobyl nuclear accident contaminated about 30,000 km^2 with greater than 10 kBq/m^2 with ^{90}Sr, which accounts for 5% of the core inventory of ^{90}Sr.[21]

Source

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