Rubidium

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Rubidium is a chemical element with symbol **Rb** and atomic number 37. Rubidium is a soft, silvery-white metallic element of the alkali metal group, with an atomic mass of 85.4678. Elemental rubidium is highly reactive, with properties similar to those of other alkali metals, including rapid oxidation in air. On Earth, natural rubidium comprises two isotopes: 72% is the stable isotope, ^{85}Rb; 28% is the slightly radioactive ^{87}Rb, with a half-life of 49 billion years—more than three times longer than the estimated age of the universe.

German chemists Robert Bunsen and Gustav Kirchhoff discovered rubidium in 1861 by the newly developed technique, flame spectroscopy.

Rubidium's compounds have various chemical and electronic applications. Rubidium metal is easily vaporized and has a convenient spectral absorption range, making it a frequent target for laser manipulation of atoms.

Rubidium is not a known nutrient for any living organisms. However, rubidium ions have the same charge as potassium ions, and are actively taken up and treated by animal cells in similar ways.

Characteristics

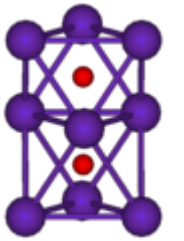
Rubidium is a very soft, ductile, silvery-white metal.[5] It is the second most electropositive of the non-radioactive alkali metals and melts at a temperature of 39.3 °C (102.7 °F). Similar to other alkali metals, rubidium metal reacts violently with water. As with potassium (which is slightly less reactive) and caesium (which is slightly more reactive), this reaction is usually vigorous enough to ignite the hydrogen gas it produces. Rubidium has also been reported to ignite spontaneously in air.[5] It forms amalgams with mercury and alloys with gold, iron, caesium, sodium, and potassium, but not lithium (even though rubidium and lithium are in the same group).[6]

Rubidium, $_{37}$Rb

General properties	
Name, symbol	rubidium, Rb
Appearance	grey white
Rubidium in the periodic table	
Atomic number (Z)	37
Group, block	group 1 (alkali metals), s-block
Period	period 5
Element category	□ alkali metal
Standard atomic weight (±) (A_r)	85.4678(3)[1]
Electron configuration	[Kr] $5s^1$
per shell	2, 8, 18, 8, 1
Physical properties	
Phase	solid
Melting point	312.45 K (39.30 °C, 102.74 °F)

Rubidium has a very low ionization energy of only 406 kJ/mol.[7] Rubidium and potassium show a very similar purple color in the flame test, and distinguishing the two elements requires something more sophisticated, such as spectroscopy.

Compounds



Rb_9O_2 cluster

Rubidium chloride (RbCl) is probably the most used rubidium compound: among several other chlorides, it is used to induce living cells to take up DNA; it is also used as a biomarker, because in nature, it is found only in small quantities in living organisms and when present, replaces potassium. Other common rubidium compounds are the corrosive rubidium hydroxide (RbOH), the starting material for most rubidium-based chemical processes; rubidium carbonate (Rb_2CO_3), used in some optical glasses, and rubidium copper sulfate, $Rb_2SO_4{\cdot}CuSO_4{\cdot}6H_2O$. Rubidium silver iodide ($RbAg_4I_5$) has the highest room temperature conductivity of any known ionic crystal, a property exploited in thin film batteries and other applications.[8][9]

Rubidium forms a number of oxides when exposed to air, including rubidium monoxide (Rb_2O), Rb_6O, and Rb_9O_2; rubidium in excess oxygen gives the superoxide RbO_2. Rubidium forms salts with halides, producing rubidium fluoride, rubidium chloride, rubidium bromide, and rubidium iodide.

Isotopes

Although rubidium is monoisotopic, rubidium in the Earth's crust is composed of two isotopes: the stable ^{85}Rb (72.2%) and the radioactive ^{87}Rb (27.8%).[10] Natural rubidium is radioactive, with specific activity of about 670 Bq/g, enough to significantly expose a photographic film in 110 days.[11][12]

Twenty four additional rubidium isotopes have been synthesized with half-lives of less than 3 months; most are highly radioactive and have few uses.

Boiling point	961 K (688 °C, 1270 °F)
Density near r.t.	1.532 g/cm^3
when liquid, at m.p.	1.46 g/cm^3
Triple point	312.41 K, ? kPa[2]
Critical point	2093 K, 16 MPa *(extrapolated)*[2]
Heat of fusion	2.19 kJ/mol
Heat of vaporization	69 kJ/mol
Molar heat capacity	31.060 J/(mol·K)

Vapor pressure

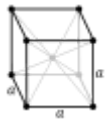
P (Pa)	**1**	**10**	**100**	**1 k**	**10 k**	**100 k**
at T (K)	434	486	552	641	769	958

Atomic properties

Oxidation states	**+1**, −1 (a strongly basic oxide)
Electronegativity	Pauling scale: 0.82
Ionization energies	1st: 403 kJ/mol 2nd: 2632.1 kJ/mol 3rd: 3859.4 kJ/mol
Atomic radius	empirical: 248 pm
Covalent radius	220±9 pm
Van der Waals radius	303 pm

Miscellanea

Crystal structure	body-centered cubic (bcc)



Rubidium-87 has a half-life of 48.8×10^9 years, which is more than three times the age of the universe of $(13.799 \pm 0.021) \times 10^9$ years,[13] making it a primordial nuclide. It readily substitutes for potassium in minerals, and is therefore fairly widespread. Rb has been used extensively in dating rocks; ^{87}Rb beta decays to stable ^{87}Sr. During fractional crystallization, Sr tends to concentrate in plagioclase, leaving Rb in the liquid phase. Hence, the Rb/Sr ratio in residual magma may increase over time, and the progressing differentiation results in rocks with elevated Rb/Sr ratios. The highest ratios (10 or more) occur in pegmatites. If the initial amount of Sr is known or can be extrapolated, then the age can be determined by measurement of the Rb and Sr concentrations and of the ^{87}Sr/^{86}Sr ratio. The dates indicate the true age of the minerals only if the rocks have not been subsequently altered (see rubidium-strontium dating).[14][15]

Rubidium-82, one of the element's non-natural isotopes, is produced by electron-capture decay of strontium-82 with a half-life of 25.36 days. With a half-life of 76 seconds, rubidium-82 decays by positron emission to stable krypton-82.[10]

Occurrence

Rubidium is the twenty-third most abundant element in the Earth's crust, roughly as abundant as zinc and rather more common than copper.[16] It occurs naturally in the minerals leucite, pollucite, carnallite, and zinnwaldite, which contain as much as 1% rubidium oxide. Lepidolite contains between 0.3% and 3.5% rubidium, and is the commercial source of the element.[17] Some potassium minerals and potassium chlorides also contain the element in commercially significant quantities.[18]

Seawater contains an average of 125 µg/L of rubidium compared to the much higher value for potassium of 408 mg/L and the much lower value of 0.3 µg/L for caesium.[19]

Because of its large ionic radius, rubidium is one of the "incompatible elements."[20] During magma crystallization, rubidium is concentrated together with its heavier analogue caesium in the liquid phase and crystallizes last. Therefore, the largest deposits of rubidium and caesium are zone pegmatite ore bodies formed by this

Speed of sound thin rod	1300 m/s (at 20 °C)
Thermal expansion	90 µm/(m·K)[3] (at r.t.)
Thermal conductivity	58.2 W/(m·K)
Electrical resistivity	128 nΩ·m (at 20 °C)
Magnetic ordering	paramagnetic[4]
Young's modulus	2.4 GPa
Bulk modulus	2.5 GPa
Mohs hardness	0.3
Brinell hardness	0.216 MPa
CAS Number	7440-17-7
History	
Discovery	Robert Bunsen and Gustav Kirchhoff (1861)
First isolation	George de Hevesy
Most stable isotopes of rubidium	

enrichment process. Because rubidium substitutes for potassium in the crystallization of magma, the enrichment is far less effective than that of caesium. Zone pegmatite ore bodies containing mineable quantities of caesium as pollucite or the lithium minerals lepidolite are also a source for rubidium as a by-product.[16]

Two notable sources of rubidium are the rich deposits of pollucite at Bernic Lake, Manitoba, Canada, and the rubicline ($(Rb,K)AlSi_3O_8$) found as impurities in pollucite on the Italian island of Elba, with a rubidium content of 17.5%.[21] Both of those deposits are also sources of caesium.

Source

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

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iso	NA	half-life	DM	DE (MeV)	DP
^{83}Rb	syn	86.2 d	ε	–	^{83}Kr
			γ	0.52, 0.53, 0.55	–
^{84}Rb	syn	32.9 d	ε	–	^{84}Kr
			β^+	1.66, 0.78	^{84}Kr
			γ	0.881	–
			β^-	0.892	^{84}Sr
^{85}Rb	72.17%	is stable with 48 neutrons			
^{86}Rb	syn	18.65 d	β^-	1.775	^{86}Sr
			γ	1.0767	–
^{87}Rb	27.83%	4.9×10^{10} y	β^-	0.283	^{87}Sr