
Handbook of Inorganic Chemicals

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Sodium thiosulfate reacts with hydrochloric acid, decomposing to sulfur and sulfur dioxide:



Analysis

Elemental composition: Concentration of sodium thiosulfate in aqueous solution can be measured by titration with a standard solution of potassium iodate, potassium biiodate, or potassium dichromate using starch indicator. The oxidant is added to an acidified solution of excess potassium iodide before titrating with the thiosulfate solution.

STRONTIUM

[7440-24-6]

Symbol Sr; atomic number 38; atomic weight 87.621; a Group II A (Group 2) alkaline earth metal positioned between calcium and barium in its group; electron configuration [Kr]5s²; valence state +2; atomic radius 2.15Å; ionic radius, Sr²⁺ 1.26Å and 1.44Å for coordination numbers 8 and 12 in crystals; standard electrode potential, E° for Sr²⁺ + 2e⁻ ↔ Sr is -2.899V; four stable natural isotopes: Sr-84(0.56%), Sr-86(9.86%), Sr-87(7.00%), Sr-88(82.58%); twenty-three artificial radioactive isotopes in the mass range 76-83, 85, 89-102; the longest-lived radioisotope is the beta emitter Sr-90, t_{1/2} 29.1 year; the shortest-lived isotope is the beta-emitter Sr-102, t_{1/2} 68ms.

History, Occurrence, and Uses

William Cruickshank in 1787 and Adair Crawford in 1790 independently detected strontium in the mineral strontianite, small quantities of which are associated with calcium and barium minerals. They determined that the strontianite was an entirely new mineral and was different from baryta and other barium minerals known at the time. In 1808, Sir Humphry Davy isolated strontium by electrolysis of a mixture of moist strontium hydroxide or chloride with mercuric oxide, using a mercury cathode. The element was named after the town Strontian in Scotland where the mineral strontianite was found.

Strontium is found in small quantities in many rocks and soils, mostly associated with calcium and barium. Its abundance in the earth's crust is about 370 mg/kg, about the same as barium. The average concentration of this metal in sea water is about 7.9 mg/L.

The two principal strontium minerals are its carbonate, strontianite, SrCO₃, and the more abundant sulfate mineral celestite, SrSO₄.

Elemental strontium has only minor uses, since most applications involve

calcium and barium. Strontium alloys are used as “getters” for vacuum tubes. It is incorporated in glass for making picture tubes for color television. Strontium compounds are used in tracer bullets and in fireworks to produce red signal flares. Strontium titanate is a gemstone. The radioactive strontium-90 with a half-life of 29 years is a high-energy beta emitter. It is a product of nuclear fission. This isotope is a lightweight nuclear-electric power source in space vehicles and remote weather stations.

Physical Properties

Silvery-white metal when freshly cut; rapidly turns yellow on exposure to air forming a thin oxide coating; face-centered cubic structure; malleable, ductile, and somewhat softer than calcium; density 2.64 g/cm³; melts at 777°C; vaporizes at 1,382°C; vapor pressure 5 torr at 847°C and 20 torr at 953°C; electrical resistivity 23 microhm-cm at 20°C; thermal neutron absorption cross section 1.21 barns; reacts with water; soluble in ethanol.

Thermochemical Properties

$\Delta H_f^\circ(\text{cry})$	0.0
$\Delta H_f^\circ(\text{gas})$	39.3 kcal/mol
$\Delta G_f^\circ(\text{gas})$	31.3 kcal/mol
$S^\circ(\text{cry})$	12.5 cal/deg mol
$S^\circ(\text{gas})$	39.3 cal/deg mol
$C_p(\text{cry})$	6.31 cal/deg mol
$C_p(\text{gas})$	4.97 cal/deg mol
ΔH_{fus}	1.78 kcal/mol
Thermal conductivity (at 27°C)	0.353 W/cm K
Coefficient of linear expansion (at 25°C)	22.5x10 ⁻⁶ /°C

Production

Strontium and its compounds are mostly derived from celestite, SrSO₄. The mineral is converted to its carbonate by heating with sodium carbonate. Alternatively, the mineral may be reduced to sulfide by heating with coke. The carbonate or the sulfide is then converted to other strontium salts.

Metallic strontium is produced by electrolysis of a mixed melt of strontium chloride and potassium chloride in a graphite crucible using an iron rod as cathode. The upper cathodic space is cooled and the strontium metal collects over the cooled cathode and forms a stick.

Strontium metal also can be prepared by thermal reduction of its oxide with aluminum. Strontium oxide-aluminum mixture is heated at high temperature in vacuum. Strontium is collected by distillation in vacuum. Strontium also is obtained by reduction of its amalgam, hydride, and other salts. The amalgam is heated and the mercury is separated by distillation. If hydride is used, it is heated at 1,000°C in vacuum for decomposition and removal of hydrogen. Such thermal reductions yield high-purity metal.

Reactions

Strontium is a reactive metal, similar to calcium. Exposure to air forms strontium oxide, SrO. In finely-divided form, the metal is pyrophoric. It