# Silicon - Si

## **Chemical properties of silicon - Health effects of silicon -** Environmental effects of silicon

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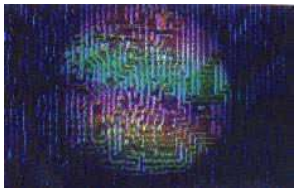
|---|---|
| **Atomic number** | 14 |
| **Atomic mass** | 28.0855 g.mol $^{-1}$ |
| **Electronegativity according to Pauling** | 1.8 |
| **Density** | 2.33 g.cm $^{-3}$ at 20 °C |
| **Melting point** | 1410 °C |
| **Boiling point** | 3265 °C |
| **Vanderwaals radius** | 0.132 nm |
| **Ionic radius** | 0.271 (-4) nm ; 0.041(+4) |
| **Isotopes** | 5 |
| **Electronic shell** | [Ne] $3s^2 3p^2$ |
| **Energy of first ionisation** | 786.3 kJ.mol $^{-1}$ |
| **Energy of second ionisation** | 1576.5 kJ.mol $^{-1}$ |
| **Energy of third ionisation** | 3228.3 kJ.mol $^{-1}$ |
| **Energy of fourth ionisation** | 4354.4 kJ.mol $^{-1}$ |
| **Discovered by** | Jons Berzelius in 1823 |



## Silicon

Silicon is the most abundant electropositive element in The Earth's crust. It's a metalloid with a marked metallic luster and very brittle. It is usually tetravalent in its compounds, although sometimes its bivalent, and it's purely electropositive in its chemical behaviour. Moreover, pentacoordinated and hexacoordinated silicon compounds are also known.

Natural silicon contains 92.2% of the isotope 28, 4.7% of silicon 29 and 3.1% of silicon 30. Apart from those stable natural isotopes, various radiactive artificial isotopes are known. Elemental silicon has the physical properties of metalloids, similar to the ones or germanium, situated under it in the group IV of the periodic table. Silicon is an intrinsic semiconductor in it's purest form, although the intensity of its semiconduction is highly increased by introducing small quantities of impurities. Silicon is similar to metals in its chemical behaviour.

It's almost as electropositive as tin and much more positive than germanium or lead. According to this metallic character, it forms tetrapositive ions and various covalent compounds; it appears as a negative ion only in a few silicides and as a positive constituent of oxyacids or complex anions.

It forms various series of hydrides, various halides (many of which contain silicon-silicon bounds) and many series of compounds which contain oxygen, which can have ionic or covalent properties.

*Applications*

Silicon is the principal component of glass, cement, ceramics, most semiconductor devices, and silicones, the latter a plastic substance often confused with silicon. Silicon is also an important constituent of some steels and a major ingredient in bricks. It is a refractory material used in making enamels and pottery.

Elemental raw silicon and its intermetallic compounds are used as alloy integrals to provide more resistance to the aluminium, magnesium, copper and other metals. Metallurgic silicon with 98-99% purity is used as raw material in the manufacture of organosilicic and silicon resins, seals and oils. Silicon chips are used in integrated circuits. Photovoltaic cells for direct conversion of solar energy use thin cut slices of simple silicon crystals of electronic grade. Silicon dioxide is used as raw material to produce elemental silicon and silicon carbide. Big silicon crystals are used for piezoelectric glasses. Melted quartz sands are transformed in silicon glasses which are used in laboratories and chemical plants, as well as in electric insulators. A colloidal dispersion of silicon in water is used as a coating agent and as ingredient for certain enamels.

It is known that silicon forms compounds with 64 out of the 96 stable elements and possibly form silicides with other 18 elements. Appart from metallic silicides, which are used in big quantities in metallurgy, it forms important commonly used compounds with hydrogen, carbon, halogens, nitrogen, oxygen and sulphur. Moreover, many useful organosilicic by-products.

*Silicon in the environment*

Silicon is found in many dioxide forms and in uncountable variations from the natural silicates.

The silicon is much more abundant than any other element, apart from the oxygen. It constitutes 27,72% of the solid Earth's crust, while the oxygen constitutes 46,6%, and the next element after silicon, aluminium, is found in a 8,13%.

Sand is used as source of the silicon produced commercially. A few siliate minerals are mined, e.g. talc and mica. Other mined silicates are feldspars, nephenile, olivine, vermiculite, perlite, kaolinite, etc. At the other extreme there are forms of silica so rare that they are desirable for this reason alone: gemstone opal, agate and rhinestone.