Magnesium

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Magnesium is a chemical element with symbol **Mg** and atomic number 12. It is a shiny gray solid which bears a close physical resemblance to the other five elements in the second column (Group 2, or alkaline earth metals) of the periodic table: all Group 2 elements have the same electron configuration in the outer electron shell and a similar crystal structure.

Magnesium is the ninth most abundant element in the universe.[4][5] It is produced in large, aging stars from the sequential addition of three helium nuclei to a carbon nucleus. When such stars explode as supernovas, much of the magnesium is expelled into the interstellar medium where it may recycle into new star systems. Magnesium is the eighth most abundant element in the Earth's crust[6] and the fourth most common element in the Earth (after iron, oxygen and silicon), making up 13% of the planet's mass and a large fraction of the planet's mantle. It is the third most abundant element dissolved in seawater, after sodium and chlorine.[7]

Magnesium occurs naturally only in combination with other elements, where it invariably has a +2 oxidation state. The free element (metal) can be produced artificially, and is highly reactive (though in the atmosphere, it is soon coated in a thin layer of oxide that partly inhibits reactivity — see passivation). The free metal burns with a characteristic brilliant-white light. The metal is now obtained mainly by electrolysis of magnesium salts obtained from brine, and is used primarily as a component in aluminium-magnesium alloys, sometimes called *magnalium* or *magnelium*. Magnesium is less dense than aluminium, and the alloy is prized for its combination of lightness and strength.

Magnesium is the eleventh most abundant element by mass in the human body and is essential to all cells and some 300 enzymes.[8] Magnesium ions interact with polyphosphate compounds such as ATP, DNA, and RNA. Hundreds of enzymes require magnesium ions to function. Magnesium compounds are

Magnesium, $_{12}$Mg

Spectral lines of magnesium

General properties

Name, symbol	magnesium, Mg
Pronunciation	/mæg'ni:ziəm/ *mag-**NEE**-zee-əm*
Appearance	shiny grey solid

Magnesium in the periodic table

Atomic number (Z)	12
Group, block	group 2 (alkaline earth metals), s-block
Period	period 3
Element category	alkaline earth metal
Standard atomic weight (A_r)	24.305[1] (24.304–24.307)[2]
Electron configuration	[Ne] $3s^2$
per shell	2, 8, 2

used medicinally as common laxatives, antacids (e.g., milk of magnesia), and to stabilize abnormal nerve excitation or blood vessel spasm in such conditions as eclampsia.[8]

Characteristics

Physical properties

Elemental magnesium is a gray-white lightweight metal, two-thirds the density of aluminium. It tarnishes slightly when exposed to air, although, unlike the other alkaline earth metals, an oxygen-free environment is unnecessary for storage because magnesium is protected by a thin layer of oxide that is fairly impermeable and difficult to remove. Magnesium has the lowest melting (923 K (1,202 °F)) and the lowest boiling point 1,363 K (1,994 °F) of all the alkaline earth metals.

Magnesium reacts with water at room temperature, though it reacts much more slowly than calcium, a similar group 2 metal. When submerged in water, hydrogen bubbles form slowly on the surface of the metal—though, if powdered, it reacts much more rapidly. The reaction occurs faster with higher temperatures (see #Precautions). Magnesium's reversible reaction with water can be harnessed to store energy and run a magnesium-based engine.

Magnesium also reacts exothermically with most acids such as hydrochloric acid (HCl), producing the metal chloride and hydrogen gas, similar to the HCl reaction with aluminium, zinc, and many other metals.

Chemical properties

Flammability

Magnesium is highly flammable, especially when powdered or shaved into thin strips, though it is difficult to ignite in mass or bulk. Flame temperatures of magnesium and magnesium alloys can reach 3,100 °C (3,370 K; 5,610 °F),[9] although flame height above the burning metal is usually less than 300 mm (12 in).[10] Once ignited, such fires are difficult to extinguish, with combustion

Physical properties

Phase	solid
Melting point	923 K (650 °C, 1202 °F)
Boiling point	1363 K (1091 °C, 1994 °F)
Density near r.t.	1.738 g/cm^3
when liquid, at m.p.	1.584 g/cm^3
Heat of fusion	8.48 kJ/mol
Heat of vaporization	128 kJ/mol
Molar heat capacity	24.869 J/(mol·K)

Vapor pressure

P (Pa)	**1**	**10**	**100**	**1 k**	**10 k**	**100 k**
at T (K)	701	773	861	971	1132	1361

Atomic properties

Oxidation states	**+2**, +1[3] (a strongly basic oxide)
Electronegativity	Pauling scale: 1.31
Ionization energies	1st: 737.7 kJ/mol 2nd: 1450.7 kJ/mol 3rd: 7732.7 kJ/mol (more)
Atomic radius	empirical: 160 pm
Covalent radius	141±7 pm
Van der Waals radius	173 pm

Miscellanea

Crystal structure	hexagonal close-packed (hcp) 
Speed of sound	4940 m/s (at r.t.) (annealed)

continuing in nitrogen (forming magnesium nitride), carbon dioxide (forming magnesium oxide and carbon), and water (forming magnesium oxide and hydrogen). This property was used in incendiary weapons during the firebombing of cities in World War II, where the only practical civil defense was to smother a burning flare under dry sand to exclude atmosphere from the combustion.

Magnesium may also be used as an igniter for thermite, a mixture of aluminium and iron oxide powder that ignites only at a very high temperature.

Source of light

When burning in air, magnesium produces a brilliant-white light that includes strong ultraviolet wavelengths. Magnesium powder (flash powder) was used for subject illumination in the early days of photography.[11][12] Later, magnesium filament was used in electrically ignited single-use photography flashbulbs. Magnesium powder is used in fireworks and marine flares where a brilliant white light is required. It was also used for various theatrical effects,[13] such as lightning,[14] pistol flashes,[15] and supernatural appearances.[16]

Occurrence

Magnesium is the eighth-most-abundant element in the Earth's crust by mass and tied in seventh place with iron in molarity.[6] It is found in large deposits of magnesite, dolomite, and other minerals, and in mineral waters, where magnesium ion is soluble.

Although magnesium is found in more than 60 minerals, only dolomite, magnesite, brucite, carnallite, talc, and olivine are of commercial importance.

thin rod	
Thermal expansion	24.8 µm/(m·K) (at 25 °C)
Thermal conductivity	156 W/(m·K)
Electrical resistivity	43.9 nΩ·m (at 20 °C)
Magnetic ordering	paramagnetic
Young's modulus	45 GPa
Shear modulus	17 GPa
Bulk modulus	45 GPa
Poisson ratio	0.290
Mohs hardness	1–2.5
Brinell hardness	44–260 MPa
CAS Number	7439-95-4
	History
Naming	after Magnesia, Greece
Discovery	Joseph Black (1755)
First isolation	Humphry Davy (1808)

Most stable isotopes of magnesium

iso	NA	half-life	DM	DE (MeV)	DP
^{24}Mg	79.0%	is stable with 12 neutrons			
^{25}Mg	10.0%	is stable with 13 neutrons			
^{26}Mg	11.0%	is stable with 14 neutrons			

The Mg^{2+} cation is the second-most-abundant cation in seawater (about ⅛ the mass of sodium ions in a given sample), which makes seawater and sea salt attractive commercial sources for Mg. To extract the magnesium, calcium hydroxide is added to seawater to form magnesium hydroxide precipitate.

$$MgCl_2 + Ca(OH)_2 \rightarrow Mg(OH)_2 + CaCl_2$$

Magnesium hydroxide (brucite) is insoluble in water and can be filtered out and reacted with hydrochloric acid to produced concentrated magnesium chloride.

$$Mg(OH)_2 + 2\ HCl \rightarrow MgCl_2 + 2\ H_2O$$

From magnesium chloride, electrolysis produces magnesium.

External links

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