



CHEMICAL PROPERTIES AND APPLICATIONS OF TUNGSTEN

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ABSTRACT

Tungsten, a chemical element, is characterized by its high melting point, strength, and hardness. This article provides detailed information about the chemical properties, structural features, and industrial significance of tungsten.

Introduction. Tungsten (W) is a chemical element, the most distinctive feature of which is its high melting point. It has a temperature of 3422 °C, making it the metal with the highest melting point. The high hardness and mechanical properties of tungsten allow it to be widely used in various industries. It is widely used in metallurgy, electronics, aviation and the nuclear industry. The article provides information about the chemical properties of tungsten, its applications and environmental significance.

Chemical properties of tungsten. The chemical properties of tungsten are not very stable and it reacts with many other metals. However, its melting point and hardness make it very durable. Tungsten reacts with other metals that react with it at very high temperatures. It can form several types of salts with acids[1]. In 1781, the Swedish chemist Carl Wilhelm Scheele isolated tungsten from the mineral tungsten (later scheelite) as tungsten dioxide WO₂. In 1783, the Spanish chemists d'Eljuyar brothers isolated WO₃ from the mineral wolframite and treated it with carbon to obtain the metal itself, which they called tungsten. Tungsten has not been used on an industrial scale for many years. It is rare in nature, and its content in the Earth's crust is 110-4% by weight. In the mineral form, it occurs mainly as tungstates. Of these, wolframite (Fe, Mn) WO and scheelite CaWO₄ are of industrial importance.

Tungsten crystallizes in cubic form, density 19.3 g/cm³, liquidus temperature 3380+10*, boiling point 5900°. At 400-500° W is significantly oxidized in air to WO, Water vapor oxidizes it to WQj above 600°. Halogens, sulfur, carbon, silicon and boron react with tungsten at high temperatures (fluorine with powdered tungsten at room temperature). It does not react with hydrogen up to the liquidus temperature; with nitrogen above 1500° it forms nitride. Under normal conditions, tungsten is resistant to the effects of chloride, sulfate, nitric and hydrofluoric acids, as well as water; at 100° it reacts slightly with them; it dissolves quickly in

a mixture of hydrofluoric and nitric acids. Tungsten in its compounds is valent from 2 to 6, and the higher valences are stable.

Tungsten forms four oxides: the upper oxide, 6-oxide WO_3 (tungsten dioxide), the lower oxide, 4-oxide WO_2 , and two intermediate oxides, WO_2 , with WO_3 . Tungsten dioxide is a lemon-colored powder that forms tungstates when dissolved in alkaline solutions. Tungstenic acid, a yellow powder insoluble in water and acids, is a tungstate acid, H_2WO_4 , which dissociates at 188° and turns into WO_3 . Tungsten forms chlorides and oxychlorides with chlorine. The most important of these are WCl_6 and WO_2Cl_2 . With sulfur, W forms two sulfides, WS_2 , and three sulfides, WS_3 . Tungsten carbides, WC and W_2C , are insoluble compounds formed by the combination of tungsten with carbon at $1000-1500^\circ$.

Tungsten uses. Tungsten ores are natural mineral formations that are useful for extracting tungsten at the modern level of technology and economics. More than 20 tungsten minerals are known (wolframite (Mn, Fe) $[WO]$, scheelite ($CaWO_4$), gübnerite $Mn[WO]$, etc.). Tungsten occurs in nature together with cassiterite (SnO_2), molybdenite (MoS_2), pyrite, copper, lead, and pure gold. Tungsten contains up to 74-76% tungsten, and scheelite contains up to 80% tungsten. Tungsten contains a large amount of tantalum and scandium in its additional form. Tungsten is purified from various impurities in enrichment plants, sorted by gravity and flotation methods, and reduced to a concentrate (50-60%). Tungsten Depending on the formation of deposits, they are divided into greisen, contact-metasomatic, hydrothermal, pegmatite-pneumatolite, and stockwork types and are genetically related to granite intrusions. Hydrothermal deposits are rich in V.r. Skarn and stockwork types are the largest deposits. V.r. deposits are found in areas where granites are widespread. Wolframite and scheelite deluvial and alluvial deposits are formed due to the leaching of primary deposits. V.r. deposits have been found in Uzbekistan (Nurota Mountains), and in foreign countries in the Russian Federation (Baikalorti, Primorye), Kazakhstan, the People's Republic of China, the Democratic People's Republic of Korea, Brazil, Bolivia, Australia, Portugal, Peru, Thailand, the USA, and Myanmar. About 80% of V.r. is used to obtain high-temperature-resistant alloys, varnishes, and corrosion-resistant materials, as well as in electrical engineering, radio engineering, and medicine.

Nuclear industry. Because tungsten has a high melting point, it is used to ensure safety in nuclear reactors. In their use, tungsten's resistance to heat and radiation is of great importance[2].

Electronics and technology. Tungsten is used in electronic components, such as heat-resistant wires and contacts. Also, tungsten's high heat resistance and electrical conductivity allow it to be used in special electrical systems.

Automotive industry. In the automotive industry, tungsten is used to manufacture various mechanical parts, especially parts used in high-temperature operating conditions, using its high hardness and toughness.

Radiotherapy. Due to its high-energy radiation emission, tungsten is used in medicine, in particular in X-ray and other imaging technologies[3].

Ecological significance and future development. The use of tungsten can raise important issues from an environmental perspective. Due to its extreme hardness and high melting point, tungsten processing and associated waste management issues may become relevant in the future[4].

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