THORIUM

Thorium
is a weakly radioactive metallic chemical element with the symbol Th and atomic number 90. Thorium is silvery and tarnishes black when it is exposed to air, forming thorium dioxide; it is moderately hard, malleable, and has a high melting point. Thorium is an electropositive actinide whose chemistry is dominated by the +4 oxidation state; it is quite reactive and can ignite in air when finely divided

POSITION

Thorium is an inner-transition element and has atomic number 90 and is present in the 3rd group and 7th period of the periodic table. It has an electronic configuration of $[Rn]6d^2 7s^2$ and belongs to the actinide family.

Birth

Thorium was discovered in 1829 by the Norwegian amateur mineralogist Morten Thrane Esmark and identified by the Swedish chemist Jöns Jacob Berzelius, who named it after Thor, the Norse god of thunder. Its first applications were developed in the late 19th century. Thorium's radioactivity was widely acknowledged during the first decades of the 20th century. In the second half of the century, thorium was replaced in many uses due to concerns about its radioactivity

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PHYSICAL PROPERTIES

It's relative atomic mass is 233.0377u, it has an atomic radius of 179.8 pm and possess +1, +2, +3, +4 oxidation states and +4 oxidation number. It's density is 11720 g/dm^3 at 293K, has molar volume 19.80 cm^3/mol at 293K and resistivity 13μΩcm at 20

ISOTOPES

Thorium ($_{90}$Th) has seven naturally occurring isotopes but none are stable. One isotope, ^{232}Th, is relatively stable, with a half-life of 1.405×10^{10} years, considerably longer than the age of the Earth, and even slightly longer than the generally accepted age of the universe. This isotope makes up nearly all natural thorium, so thorium was considered to be mononuclidic. However, in 2013, IUPAC reclassified thorium as binuclidic, due to large amounts of ^{230}Th in deep seawater. Thorium has a characteristic terrestrial isotopic composition and thus a standard atomic weight can be given. Thirty-one radioisotopes have been characterized, with the most stable being ^{232}Th, ^{230}Th with a half-life of 75,380 years, ^{229}Th with a half-life of 7,917 years,and ^{228}Th with a half-life of 1.92 years. All of the remaining radioactive isotopes have half-lives that are less than thirty days and the majority of these have half-lives that are less than ten minutes. One isotope, ^{229}Th, has a nuclear isomer (or metastable state) with a remarkably low excitation energy, recently measured to be 8.28 ± 0.17 eV. It has been proposed to perform laser spectroscopy of the ^{229}Th nucleus and use the low-energy transition for the development of a nuclear clock of extremely high accuracy.

CHEMICAL PROPERTIES

It is a radioactive element. Thorium oxides can be used as nuclear fuels, although this application is quite limited compared with uranium oxide materials. In contrast to the well-known properties of bulk thorium oxides, thorium oxide molecules are much less understood. This book discusses the chemical properties, uses and environmental effects of thorium. Topics discussed include the products of laser ablated thorium atom reactions with small molecules; soil profile thorium and uranium concentration distributions in southeastern Missouri soils; influences of coal-fired power plants on the thorium levels in soils and on radioactive hazards for the population; behaviour of Th-isotopes along the pigment TiO_2 industrial production process; some features of the Th presence in the poços de Caldas alkaline massif, Brazil; geological and geophysical implications for western Australia; hermophysical and thermodynamic properties of oxygen-containing compounds of thorium; and unique role of thorium in closed (Th-U-Pu)-fuel cycle due to the involvement of hybrid "fusion-fission" reactors to generate advanced (231Pa+232U+233U)-fuel. Thorium is a radionuclide present in the environment as Th(IV) and often used as homologue of tetravalent actinides because it can be handled easily in the laboratory. Nuclear fuel cycle, mining and milling operations of radioactive ores but also catalysis, pigments production, fossil fuels and phosphate fertilizers are the main sources of thorium contamination.

Main isotopes of thorium ($_{90}$Th)

Isotope			Decay	
	abun-dance	half-life ($t_{1/2}$)	mode	pro-duct
^{227}Th	trace	18.68 d	α	^{223}Ra
^{228}Th	trace	1.9116 y	α	^{224}Ra
^{229}Th	trace	7917 y[1]	α	^{225}Ra
^{230}Th	0.02%	75400 y	α	^{226}Ra
^{231}Th	trace	25.5 h	β^-	^{231}Pa
^{232}Th	99.98%	1.405×10^{10} y	α	^{228}Ra
^{234}Th	trace	24.1 d	β^-	^{234}Pa

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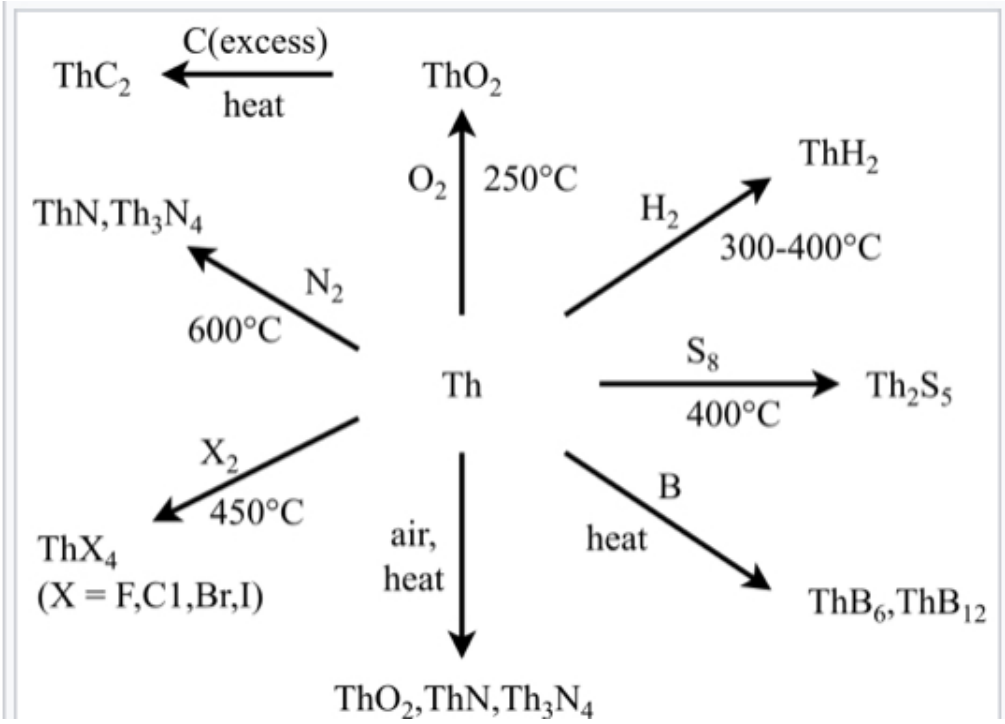
Daily life usage

Thorium is used as an alloying agent to improve magnesium's strength at high temperatures. Thorium is also used to coat tungsten filaments used in electronic devices, such at television sets. When bombarded with neutrons, thorium-232 becomes thorium-233 which eventually decays into uranium-233 through a series of beta decays. Uranium-233 is a fissionable material and can be used as a nuclear fuel. Thorium oxide (ThO_2), one of thorium's compounds, has many uses. It is primarily used in a type of lantern mantel known as a Welsbach mantle. This mantle, which also contains about 1% cerium oxide, glows with a bright white light when it is heated in a gas flame. Thorium oxide has a very high melting point, about 3300°C, and is used to make high temperature crucibles. Thorium oxide is also used to make glass with a high index of refraction that is used to make high quality camera lenses. Thorium oxide is used as a catalyst in the production of sulfuric acid (H_2SO_4), in the cracking of petroleum products and in the conversion of ammonia (NH_3) to nitric acid (HNO_3).
Thorium's most stable isotope, thorium-232, has a half-life of about 14,050,000,000 years. It decays into radium-228 through alpha decay or decays through spontaneous fission.

Uniqueness quotient

It is named after 'Thor'-The god of thunder which sets is unique from all other elements

Compounds formed by thorium



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