

= Yttrium =

Yttrium is a chemical element with symbol Y and atomic number 39 . It is a silvery @-@ metallic transition metal chemically similar to the lanthanides and has often been classified as a " rare earth element " . Yttrium is almost always found in combination with lanthanide elements in rare earth minerals , and is never found in nature as a free element . 89Y is the only stable isotope , and the only isotope found in the Earth 's crust .

In 1787 , Carl Axel Arrhenius found a new mineral near Ytterby in Sweden and named it ytterbite , after the village . Johan Gadolin discovered yttrium 's oxide in Arrhenius ' sample in 1789 , and Anders Gustaf Ekeberg named the new oxide yttria . Elemental yttrium was first isolated in 1828 by Friedrich Wöhler .

The most important uses of yttrium are LEDs and phosphors , particularly the red phosphors in television set cathode ray tube (CRT) displays . Yttrium is also used in the production of electrodes , electrolytes , electronic filters , lasers , superconductors , various medical applications , and tracing various materials to enhance their properties .

Yttrium has no known biological role and exposure to yttrium compounds can cause lung disease in humans .

= = Characteristics = =

= = = Properties = = =

Yttrium is a soft , silver @-@ metallic , lustrous and highly crystalline transition metal in group 3 . As expected by periodic trends , it is less electronegative than its predecessor in the group , scandium , and less electronegative than the next member of period 5 , zirconium ; additionally , it is of comparable electronegativity to its successor in its group , lutetium , due to the lanthanide contraction . Yttrium is the first d @-@ block element in the fifth period .

The pure element is relatively stable in air in bulk form , due to passivation of a protective oxide (Y₂O₃

) film that forms on the surface . This film can reach a thickness of 10 µm when yttrium is heated to 750 ° C in water vapor . When finely divided , however , yttrium is very unstable in air ; shavings or turnings of the metal can ignite in air at temperatures exceeding 400 ° C. Yttrium nitride (YN) is formed when the metal is heated to 1000 ° C in nitrogen .

= = = Similarity to the lanthanides = = =

The similarities of yttrium to the lanthanides are so strong that the element has historically been grouped with them as a rare earth element , and is always found in nature together with them in rare earth minerals . Chemically , yttrium resembles those elements more closely than its neighbor in the periodic table , scandium , and if physical properties were plotted against atomic number , it would have an apparent number of 64 @.@ 5 to 67 @.@ 5 , placing it between the lanthanides gadolinium and erbium .

It often also falls in the same range for reaction order , resembling terbium and dysprosium in its chemical reactivity . Yttrium is so close in size to the so @-@ called ' yttrium group ' of heavy lanthanide ions that in solution , it behaves as if it were one of them . Even though the lanthanides are one row farther down the periodic table than yttrium , the similarity in atomic radius may be attributed to the lanthanide contraction .

One of the few notable differences between the chemistry of yttrium and that of the lanthanides is that yttrium is almost exclusively trivalent , whereas about half the lanthanides can have valences other than three .

= = = Compounds and reactions = = =

As a trivalent transition metal, yttrium forms various inorganic compounds, generally in the oxidation state of + 3, by giving up all three of its valence electrons. A good example is yttrium (III) oxide (Y

2O

3), also known as yttria, a six @-@ coordinate white solid.

Yttrium forms a water @-@ insoluble fluoride, hydroxide, and oxalate, but its bromide, chloride, iodide, nitrate and sulfate are all soluble in water. The Y³⁺ ion is colorless in solution because of the absence of electrons in the d and f electron shells.

Water readily reacts with yttrium and its compounds to form Y

2O

3. Concentrated nitric and hydrofluoric acids do not rapidly attack yttrium, but other strong acids do

With halogens, yttrium forms trihalides such as yttrium (III) fluoride (YF

3), yttrium (III) chloride (YCl

3), and yttrium (III) bromide (YBr

3) at temperatures above roughly 200 ° C. Similarly, carbon, phosphorus, selenium, silicon and sulfur all form binary compounds with yttrium at elevated temperatures.

Organoyttrium chemistry is the study of compounds containing carbon ? yttrium bonds. A few of these are known to have yttrium in the oxidation state 0. (The + 2 state has been observed in chloride melts, and + 1 in oxide clusters in the gas phase.) Some trimerization reactions were generated with organoyttrium compounds as catalysts. These syntheses use YCl

3 as a starting material, obtained from Y

2O

3 and concentrated hydrochloric acid and ammonium chloride.

Hapticity is a term to describe the coordination of a group of contiguous atoms of a ligand bound to the central atom; it is indicated by the Greek character eta, η . Yttrium complexes were the first examples of complexes where carboranyl ligands were bound to a d⁰ @-@ metal center through a η^7 @-@ hapticity. Vaporization of the graphite intercalation compounds graphite ? Y or graphite ? Y

2O

3 leads to the formation of endohedral fullerenes such as Y @ C₈₂. Electron spin resonance studies indicated the formation of Y³⁺ and (C₈₂)³⁻ ion pairs. The carbides Y₃C, Y₂C, and YC₂ can be hydrolyzed to form hydrocarbons.

== Nucleosynthesis and isotopes ==

Yttrium in the Solar System was created through stellar nucleosynthesis, mostly by the s @-@ process (? 72 %), but also by the r @-@ process (? 28 %). The r @-@ process consists of rapid neutron capture of lighter elements during supernova explosions. The s @-@ process is a slow neutron capture of lighter elements inside pulsating red giant stars.

Yttrium isotopes are among the most common products of the nuclear fission of uranium in nuclear explosions and nuclear reactors. In the context of nuclear waste management, the most important isotopes of yttrium are ⁹¹Y and ⁹⁰Y, with half @-@ lives of 58 @. 51 days and 64 hours, respectively. Though ⁹⁰Y has a short half @-@ life, it exists in secular equilibrium with its long @-@ lived parent isotope, strontium @-@ 90 (⁹⁰Sr) with a half @-@ life of 29 years.