Actinium - Ac

Chemical properties **of actinium - Health effects of actinium - Environmental effects of actinium**

Atomic number	89
Atomic mass	227 g.mol $^{-1}$
Electronegativity according to Pauling	1.1
Density	10.07 g.cm^{-3} at 20°C
Melting point	1050 °C
Boiling point	3250 °C
Vanderwaals radius	unknown
Ionic radius	unknown
Isotopes	4
Electronic shell	[Rn] 6d^{1} 7s^{2}
Energy of first ionization	664.6 kJ.mol $^{-1}$
Energy of second ionization	1165.5 kJ.mol $^{-1}$
Discovered by	André Debierne in 1899

Actinium

Actinium is a silvery radioactive metallic element. Actinium glows in the dark due to its intense radioactivity with a blue light.

Actinium was discovered in 1899 by André-Louis Debierne, a French chemist, who separated it from pitchblende. Friedrich Otto Giesel independently discovered actinium in 1902. The chemical behavior of actinium is similar to that of the rare earth lanthanum.

The word actinium comes from the Greek *aktis, aktinos, meaning beam or ray.*

Applications

It is about 150 times as radioactive as radium, making it valuable as a neutron source. Otherwise it has no significant industrial applications.

Actinium-225 is used in medicine to produce Bi-213 in a reusable generator or can be used alone as an agent for radio-immunotherapy.

Actinium in the environment

It is found only in traces in uranium ores as 227-Ac, an α and β emitter with a half-life of 21.773 years. One ton of uranium ore contains about a tenth of a gram of actinium. Actinium is found in trace amounts in uranium ore, but more commonly is made in milligram amounts by the neutron irradiation of 226-Ra in a nuclear reactor. Actinium metal has been prepared by the reduction of actinium fluoride with lithium vapor at about 1100 to 1300-degrees C.

Naturally occurring actinium is composed of 1 radioactive isotope; with 227-Ac being the most abundant (100% natural abundance). 27 radioisotopes have been characterized with the most stable being 227-Ac with a half-life of 21.773 years, 225-Ac with a half-life of 10 days, and 226-Ac with a half-life of 29.37 hours. All of the remaining radioactive isotopes have half-life's that are less than 10 hours and the majority of these have half life's that are less than 1 minute. This element also has 2 meta states.

Purified actinium-227 comes into equilibrium with its decay products at the end of 185 days, and then decays according to its 21.773-year half-life.

The isotopes of actinium range in atomic weight from 206 amu (206-actinium) to 234 amu (234-actinium).

Health effects of actinium

Actinium-227 is extremely radioactive, and in terms of its potential for radiation induced health effects, actinium-227 is about as dangerous as plutonium. Ingesting even small amounts of actinium-227 would represent a serious health hazard.

The greatest threat of radioactivity to life as we know it is damage to the gene pool, the genetic make-up of all living species. Genetic damage from radiation exposure is cumulative over lifetimes and generations.

Even low-dose exposures are carcinogenic after extended exposure. The current generation, the one in uterus, and all that follow may suffer cancers, immune system damage, leukemia, miscarriages, stillbirths, deformities, and fertility problems. While many of these health problems are on the rise, individuals cannot prove either increase in "background" radiation or specific exposure as the cause. Only epidemiological evidence is scientifically acceptable to impute cause. Perhaps the most extreme outcome over time would be simply the wholesale cessation of the ability to reproduce. Radiation is a known cause of sterility.

Environmental effects of actinium

The development of nuclear technology has been accompanied by gross as well as minute releases of radioactivity into the atmosphere, the soil, the oceans, seas, and water table, showing up worldwide in animal, vegetable, and inert matter. Radiation crosses species and concentrates through the food chain, subjecting other animals and humans to its damaging effects.