PubChem

Erbium

Erbium is a chemical element with symbol Er and atomic number 68. Classified as a lanthanide, erbium is a solid at room temperature.

68
Er
Erbium

Atomic Mass	167.26u
Electron Configuration	$[Xe]6s^2 4f^{12}$
Oxidation States	+3
Year Discovered	1843

View All Properties

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	**	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Nh	Fl	Mc	Lv	Ts	Og

*	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
**	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

1 Identifiers

1.1 Element Name

Erbium

PubChem; Commission on Isotopic Abundances and Atomic Weights (CIAAW), International Union of Pure and Applied Chemistry (IUPAC)

1.2 Element Symbol

Er

PubChem; Commission on Isotopic Abundances and Atomic Weights (CIAAW), International Union of Pure and Applied Chemistry (IUPAC)

1.3 InChI

InChI=1S/Er

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1.4 InChI Key

UYAHIZSMUZPPFV-UHFFFAOYSA-N

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2 Properties

2.1 Atomic Weight

167.259(3)

- Commission on Isotopic Abundances and Atomic Weights (CIAAW), International Union of Pure and Applied Chemistry (IUPAC); NIST Physical Measurement Laboratory

167.259

- Jefferson Lab, U.S. Department of Energy

167.3

- Los Alamos National Laboratory, U.S. Department of Energy

2.2 Electron Configuration

$[Xe]6s^2 4f^{12}$

- Los Alamos National Laboratory, U.S. Department of Energy

2.3 Atomic Radius

Van der Waals Atomic Radius

235 pm (Van der Waals)

- Los Alamos National Laboratory, U.S. Department of Energy

Empirical Atomic Radius

175 pm (Empirical)

J.C. Slater, J Chem Phys, 1964, 41(10), 3199-3205. ***DOI:10.1063/1.1725697***

- PubChem Elements

Covalent Atomic Radius

189(6) pm (Covalent)

B. Cordero, V. Gómez, A.E. Platero-Prats, M. Revés, J. Echeverría, E. Cremades, F. Barragán, S. Alvarez, Dalton Trans. 2008, 21, 2832-2838. ***DOI:10.1039/b801115j PMID:18478144.***

- PubChem Elements

2.4 Oxidation States

+3

- Jefferson Lab, U.S. Department of Energy

3, 2, 1 (a basic oxide)

- Los Alamos National Laboratory, U.S. Department of Energy

2.5 Ground Level

$^3H_6$

- NIST Physical Measurement Laboratory

2.6 Ionization Energy

6.108 eV

- Jefferson Lab, U.S. Department of Energy

6.1077 ± 0.0010 eV

First Ionization Potentials of Lanthanides by Laser Spectroscopy, E. F. Worden, R. W. Solarz, J. A. Paisner, and J. G. Conway, J. Opt. Soc. Am. 68, 52–61 (1978) ***DOI:10.1364/JOSA.68.000052***

▸ NIST Physical Measurement Laboratory

2.7 Electronegativity

Pauling Scale Electronegativity

1.24 (Pauling Scale)

A.L. Allred, J. Inorg. Nucl. Chem., 1961, 17(3-4), 215-221. ***DOI:10.1016/0022-1902(61)80142-5***

▸ PubChem Elements

2.8 Atomic Spectra

Lines Holdings

▸ NIST Physical Measurement Laboratory

Levels Holdings

▸ NIST Physical Measurement Laboratory

2.9 Physical Description

Solid

▸ Jefferson Lab, U.S. Department of Energy

2.10 Element Classification

Metal

▸ Jefferson Lab, U.S. Department of Energy

2.11 Element Period Number

6

▸ Jefferson Lab, U.S. Department of Energy

2.12 Element Group Number

- Lanthanide

▸ Jefferson Lab, U.S. Department of Energy

2.13 Density

9.07 grams per cubic centimeter

▸ Jefferson Lab, U.S. Department of Energy

2.14 Melting Point

1802 K (1529°C or 2784°F)

▸ Jefferson Lab, U.S. Department of Energy

1529°C

▸ Los Alamos National Laboratory, U.S. Department of Energy

2.15 Boiling Point

3141 K (2868°C or 5194°F)

Jefferson Lab, U.S. Department of Energy

2868°C

Los Alamos National Laboratory, U.S. Department of Energy

2.16 Estimated Crustal Abundance

3.5 milligrams per kilogram

Jefferson Lab, U.S. Department of Energy

2.17 Estimated Oceanic Abundance

8.7×10^{-7} milligrams per liter

Jefferson Lab, U.S. Department of Energy

3 History

The name derives from the Swedish town of Ytterby, where the ore gadolinite (in which it was found) was first mined. Erbium was discovered by the Swedish surgeon and chemist Carl-Gustav Mosander in 1843 in a yttrium sample. He separated the yttrium into yttrium, a rose-coloured salt he called terbium and a deep-yellow peroxide that he called erbium.

▸ Commission on Isotopic Abundances and Atomic Weights (CIAAW), International Union of Pure and Applied Chemistry (IUPAC)

The mineral gadolinite ($(Ce, La, Nd, Y)_2FeBe_2Si_2O_{10}$), discovered in a quarry near the town of Ytterby, Sweden, has been the source of a great number of rare earth elements. In 1843, Carl Gustaf Mosander, a Swedish chemist, was able to separate gadolinite into three materials, which he named yttria, erbia and terbia. As might be expected considering the similarities between their names and properties, scientists soon confused erbia and terbia and, by 1877, had reversed their names. What Mosander called erbia is now called terbia and visa versa. From these two substances, Mosander discovered two new elements, terbium and erbium. Today, erbium is primarily obtained through an ion exchange process from the minerals xenotime (YPO_4) and euxenite ($(Y, Ca, Er, La, Ce, U, Th)(Nb, Ta, Ti)_2O_6$).

▸ Jefferson Lab, U.S. Department of Energy

Erbium, one of the so-called rare-earth elements on the lanthanide series, is found in the minerals mentioned under dysprosium. In 1842 Mosander separated "yttria" found in the mineral gadolinite, into three fractions which he called yttria, erbia, and terbia. The names erbia and terbia became confused in this early period. After 1860, Mosander's terbia was known as erbia, and after 1877, the earlier known erbia became terbia. The erbia of this period was later shown to consist of five oxides, now known as erbia, scandia, holmia, thulia and ytterbia. By 1905 Urbain and James independently succeeded in isolating fairly pure Er_2O_3. Klemm and Bommer first produced reasonably pure erbium metal in 1934 by reducing the anhydrous chloride with potassium vapor.

▸ Los Alamos National Laboratory, U.S. Department of Energy

4 Description

The pure metal is soft and malleable and has a bright, silvery, metallic luster. As with other rare-earth metals, its properties depend to a certain extent on the impurities present. The metal is fairly stable in air and does not oxidize as rapidly as some of the other rare-earth metals. Naturally occurring erbium is a mixture of six isotopes, all of which are stable. Nine radioactive isotopes of erbium are also recognized. Recent production techniques, using ion-exchange reactions, have resulted in much lower prices of the rare-earth metals and their compounds in recent years. Most of the rare-earth oxides have sharp absorption bands in the visible, ultraviolet, and near infrared. This property, associated with the electronic structure, gives beautiful pastel colors to many of the rare-earth salts.

▸ Los Alamos National Laboratory, U.S. Department of Energy

5 Uses

Erbium is alloyed with vanadium to make it softer and easier to shape. Erbium is added to fiber optic cables as a doping agent where it is used as a signal amplifier. Erbium also has some uses in the nuclear power industry.

Erbia, the renamed material that Mosander discovered in 1843, is erbium oxide (Er_2O_3), one of erbium's compounds. Erbia has a pink color and is used to color glass and glazes. Other erbium compounds include: erbium fluoride (ErF_3, erbium chloride ($ErCl_3$ and erbium iodide (ErI_3).

- Jefferson Lab, U.S. Department of Energy

Erbium is finding nuclear and metallurgical uses. Added to vanadium, for example, erbium lowers the hardness and improves workability. Erbium oxide gives a pink color and has been used as a colorant in glasses and porcelain enamel glazes.

- Los Alamos National Laboratory, U.S. Department of Energy

6 Compounds

See more information at the Erbium compound page.

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6.1 Element Forms

CID	Name	Formula	SMILES	Molecular Weight
23980	erbium	Er	[Er]	167.259
161153	erbium-169	Er	[169Er]	168.935
177431	erbium-171	Er	[171Er]	170.938
177481	erbium-168	Er	[168Er]	167.932
177497	erbium-166	Er	[166Er]	165.93
177526	erbium-161	Er	[161Er]	160.93
177635	erbium-170	Er	[170Er]	169.935
177697	erbium-172	Er	[172Er]	171.939
178160	erbium-165	Er	[165Er]	164.931
3779597	erbium(3+)	Er+3	[Er+3]	167.259
131708394	erbium-162	Er	[162Er]	161.929
131708395	erbium-164	Er	[164Er]	163.929
131708396	erbium-167	Er	[167Er]	166.932

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7 Isotopes

Stable Isotope Count

6

Jefferson Lab, U.S. Department of Energy

7.1 Isotopes in Biology

Radiolabeled ^{171}Er (with a half-life of 7.5 h) tablets have been used to study bowel movements of individuals using external scintigraphy. Such tablets have an enteric coating and contain small amounts of stable erbium oxide (^{170}Er) initially. The tablets are then irradiated at a low neutron flux to produce radioactively labeled ^{171}Er tablets, via the ^{170}Er (n, γ) ^{171}Er reaction. This method is a noninvasive approach for determining gastric emptying rates and visualizing segments of the digestive system in an individual [479], [480].

[479] A. Parr, R. M. Beihn, M. Jay. Int. J. Pharm.32, 251 (1986).
[480] M. C. Theodorakis. Am. Physiol. Soc. Gastrointest. Liver Physiol.239, G39 (1980).

IUPAC Periodic Table of the Elements and Isotopes (IPTEI)

7.2 Isotopes in Medicine

^{169}Er (with a half-life of 9.4 days) is used in radiosynovectomy, which is a regularly practiced radiotherapy, on rheumatoid arthritis patients whose condition is resistant to standard methods of treatment (Fig. IUPAC.68.1). Rheumatoid arthritis is a chronic, inflammatory, autoimmune disease of the joint capsule (synovial sac), which is lined with a thin membrane called the synovium, of an individual's moveable joints (synovial joints). In radiosynovectomy, the radiopharmaceutical called ^{169}Er- citrate colloid, which contains colloidal particles that are labeled with β-emitting ^{169}Er, is directly injected into the synovial cavity (the cavity between the bones in a moveable joint inside of the synovium) of the affected joint. These radioactive-colloid particles are then phagocytized (engulfed) by macrophage-like synoviocytes as well as other phagocytizing inflammatory cells in the patient's synovium. Necrosis (tissue death) and the inhabitation of cell proliferation (increase in number of cells) result from the radiation of the synovium and therefore, temporarily halts synovitis (which is the condition of when the synovium thickens with inflammation) and improves synovial joint function [481], [482], [483], [484].

Fig. IUPAC.68.1: Normal joint (top) vs. joint affected by rheumatoid arthritis (bottom) (modified from [485]).

[481] F. M. van der Zanta, Z. N. Jahangierb, G. G. M. Gommansa, J. D. Moolenburghc, J. W. G. Jacobs. Appl. Radiat. Isot.65, 649 (2007).
[482] S. J. Kim, K. A. Jung. Clin. Med. Res.5, 244 (2007).
[483] M. E. A. McNeil. The First Year Rheumatoid Arthritis: An Essential Guide for the Newly Diagnosed, Marlowe & Company, New York, NY (2005).
[484] G. Prabhakar, S. S. Sachdev, N. Sivaprasad. Pharma Times41, 11 (2009).
[485] National Institute of Arthritis and Musculoskeletal and Skin Diseases. Normal Joint Versus Joint Affected by Rheumatoid Arthritis.

IUPAC Periodic Table of the Elements and Isotopes (IPTEI)

7.3 Isotope Mass and Abundance

Isotope	Atomic Mass (uncertainty) [u]	Abundance (uncertainty)
^{162}Er	161.928 787(6)	0.001 39(5)
^{164}Er	163.929 207(5)	0.016 01(3)
^{166}Er	165.930 299(8)	0.335 03(36)
^{167}Er	166.932 054(8)	0.228 69(9)
^{168}Er	167.932 376(8)	0.269 78(18)
^{170}Er	169.935 47(1)	0.149 10(36)

Commission on Isotopic Abundances and Atomic Weights (CIAAW), International Union of Pure and Applied Chemistry (IUPAC)

Isotope	Atomic Mass (uncertainty) [u]	Abundance (uncertainty)
^{162}Er	161.9287884(20)	0.00139(5)
^{164}Er	163.9292088(20)	0.01601(3)
^{166}Er	165.9302995(22)	0.33503(36)
^{167}Er	166.9320546(22)	0.22869(9)
^{168}Er	167.9323767(22)	0.26978(18)
^{170}Er	169.9354702(26)	0.14910(36)

NIST Physical Measurement Laboratory

7.4 Atomic Mass, Half Life, and Decay

Nuclide	Atomic Mass and Uncertainty [u]	Half Life and Uncertainty	Discovery Year	Decay Modes, Intensities and Uncertainties [%]
^{142}Er	141.970016 ± 0.000537 [Estimated]	10 us [Estimated]		p ?
^{143}Er	142.966548 ± 0.000429 [Estimated]	200 ms [Estimated]	2005	β^+ ?; β^+p ?
^{144}Er	143.960700 ± 0.00021 [Estimated]	400 ms ± >200ns [Estimated]	2003	β^+ ?
^{145}Er	144.957874 ± 0.000215 [Estimated]	900 ms ± 200	1989	β^+=100%; β^+p=?
^{145}Er^m	144.957874 ± 0.000215 [Estimated]	1.0 s ± 0.3	2010	β^+=100%; IT ?; β^+p=?
^{146}Er	145.952418357 ± 0.000007197	1.7 s ± 0.6	1993	β^+=100%; β^+p=?
^{147}Er	146.949964456 ± 0.000041	3.2 s ± 1.2	1992	β^+=100%; β^+p=?
^{147}Er^m	146.949964456 ± 0.000041	1.6 s ± 0.2	1982	β^+=100%; β^+p=?
^{148}Er	147.944735026 ± 0.000011	4.6 s ± 0.2	1982	β^+=100%; β^+p≈0.15%
^{148}Er^m	147.944735026 ± 0.000011	13 us ± 3	1982	IT=100%
^{149}Er	148.942306000 ± 0.00003	4 s ± 2	1984	β^+=100%; β^+p=7±0.2%
^{149}Er^m	148.942306000 ± 0.00003	8.9 s ± 0.2	1984	β^+=96.5±0.7%; IT=3.5±0.7%; β^+p=0.18±0.7%
^{149}Er^n	148.942306000 ± 0.00003	610 ns ± 80	1987	IT=100%
^{149}Er^p	148.942306000 ± 0.00003	4.8 us ± 0.1	1987	IT=100%
^{150}Er	149.937915524 ± 0.000018458	18.5 s ± 0.7	1982	β^+=100%
^{150}Er^m	149.937915524 ± 0.000018458	2.55 us ± 0.10	1984	IT=100%
^{151}Er	150.937448567 ± 0.000017681	23.5 s ± 2.0	1970	β^+=100%
^{151}Er^m	150.937448567 ± 0.000017681	580 ms ± 20	1980	IT=95.3±0.3%; β^+=4.7±0.3%
^{151}Er^n	150.937448567 ± 0.000017681	420 ns ± 50	1990	IT=100%
^{152}Er	151.935050347 ± 0.000009478	10.3 s ± 0.1	1963	α=90±0.4%; β^+=10±0.4%
^{153}Er	152.935086350 ± 0.000009967	37.1 s ± 0.2	1963	α=53±0.3%; β^+=47±0.3%

Nuclide	Atomic Mass and Uncertainty [u]	Half Life and Uncertainty	Discovery Year	Decay Modes, Intensities and Uncertainties [%]
$^{153}Er^{m}$	152.935086350 ± 0.000009967	373 ns ± 9	1979	IT=100%
$^{153}Er^{n}$	152.935086350 ± 0.000009967	248 ns ± 32	1979	IT=100%
^{154}Er	153.932790799 ± 0.000005325	3.73 m ± 0.09	1963	β⁺≈100%; α=0.47±1.3%
^{155}Er	154.933215710 ± 0.00000652	5.3 m ± 0.3	1969	β⁺=99.978±0.7%; α=0.022±0.7%
^{156}Er	155.931065926 ± 0.00002644	19.5 m ± 1.0	1967	β⁺=100%; α=1.2e-5±0.3%
^{157}Er	156.931922652 ± 0.000028454	18.65 m ± 0.10	1966	β⁺=100%
$^{157}Er^{m}$	156.931922652 ± 0.000028454	76 ms ± 6	1971	IT=100%
^{158}Er	157.929893474 ± 0.000027074	2.29 h ± 0.06	1961	ε=100%
^{159}Er	158.930690790 ± 0.00000391	36 m ± 1	1962	β⁺=100%
$^{159}Er^{m}$	158.930690790 ± 0.00000391	337 ns ± 14	1971	IT=100%
$^{159}Er^{n}$	158.930690790 ± 0.00000391	590 ns ± 60	1971	IT=100%
^{160}Er	159.929077193 ± 0.000026029	28.58 h ± 0.09	1954	ε=100%
^{161}Er	160.930003530 ± 0.000009419	3.21 h ± 0.03	1954	β⁺=100%
$^{161}Er^{m}$	160.930003530 ± 0.000009419	7.5 us ± 0.7	1969	IT=100%
^{162}Er	161.928787299 ± 0.000000811	Stable ± >140Ty	1938	IS=0.139±0.5%; α ?; 2β⁺ ?
$^{162}Er^{m}$	161.928787299 ± 0.000000811	88 ns ± 16	1974	IT=100%
^{163}Er	162.930039908 ± 0.000004967	75.0 m ± 0.4	1953	β⁺=100%
$^{163}Er^{m}$	162.930039908 ± 0.000004967	580 ns ± 100	1974	IT=100%
^{164}Er	163.929207739 ± 0.000000755	Stable	1938	IS=1.601±0.3%; α ?; 2β⁺ ?
^{165}Er	164.930733482 ± 0.000000985	10.36 h ± 0.04	1950	ε=100%
$^{165}Er^{m}$	164.930733482 ± 0.000000985	250 ns ± 30	1970	IT=100%
$^{165}Er^{n}$	164.930733482 ± 0.000000985	370 ns ± 40	2012	IT=100%
^{166}Er	165.930301067 ± 0.000000358	Stable	1934	IS=33.503±3.6%
^{167}Er	166.932056192 ± 0.000000306	Stable	1934	IS=22.869±0.9%
$^{167}Er^{m}$	166.932056192 ± 0.000000306	2.269 s ± 0.006	1986	IT=100%
^{168}Er	167.932378282 ± 0.00000028	Stable	1934	IS=26.978±1.8%
$^{168}Er^{m}$	167.932378282 ± 0.00000028	109.0 ns ± 0.7	1974	IT=100%
^{169}Er	168.934598444 ± 0.000000326	9.392 d ± 0.018	1956	β⁻=100%
$^{169}Er^{m}$	168.934598444 ± 0.000000326	285 ns ± 20	1969	IT=100%
$^{169}Er^{n}$	168.934598444 ± 0.000000326	200 ns ± 10	1969	IT=100%
^{170}Er	169.935471933 ± 0.000001488	Stable ± >410Py	1934	IS=14.910±3.6%; 2β⁻ ?; α ?
^{171}Er	170.938037372 ± 0.000001511	7.516 h ± 0.002	1938	β⁻=100%
$^{171}Er^{m}$	170.938037372 ± 0.000001511	210 ns ± 10	1969	IT=100%
^{172}Er	171.939363461 ± 0.000004253	49.3 h ± 0.5	1956	β⁻=100%
$^{172}Er^{m}$	171.939363461 ± 0.000004253	579 ns ± 62	2006	IT=100%
^{173}Er	172.942400 ± 0.00021 [Estimated]	1.434 m ± 0.017	1972	β⁻=100%
^{174}Er	173.944230 ± 0.00032 [Estimated]	3.2 m ± 0.2	1989	β⁻=100%
$^{174}Er^{m}$	173.944230 ± 0.00032 [Estimated]	3.9 s ± 0.3	2006	IT=100%
^{175}Er	174.947770 ± 0.00043 [Estimated]	1.2 m ± 0.3	1996	β⁻=100%
^{176}Er	175.949940 ± 0.00043 [Estimated]	12 s ± >300ns [Estimated]	2012	β⁻ ?
^{177}Er	176.953990 ± 0.00054 [Estimated]	8 s ± >300ns [Estimated]	2012	β⁻ ?
^{178}Er	177.956779 ± 0.00064 [Estimated]	4 s ± >300ns [Estimated]	2012	β⁻ ?
^{179}Er	178.961267 ± 0.000537 [Estimated]	3 s ± >550ns [Estimated]	2018	β⁻ ?; β⁻n ?
^{180}Er	179.964380 ± 0.000537 [Estimated]	2 s ± >550ns [Estimated]	2018	β⁻ ?; β⁻n ?

Atomic Mass Data Center (AMDC), International Atomic Energy Agency (IAEA)

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