Eu-Europium

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https://en.wikipedia.org/wiki/Europium#/media/File:Europium.jpg

Content

ELEMENT

CHEMISTRY and COMPOUNDS

SPECIFIC FUNCTIONALITIES/APPLICATIONS

Element

Discovery and origin of the name

- The name is derived from the continent of Europe.
- Discovered by a French chemist, Eugène-Antole Demarçay in 1896.
- Demarçay suspected that samarium which was recently discovered was contamined with another element. He identified spectroscopic lines in the samarium spectrum that belonged to the element europium.
- Demarçay was able to produce pure europium in 1901.

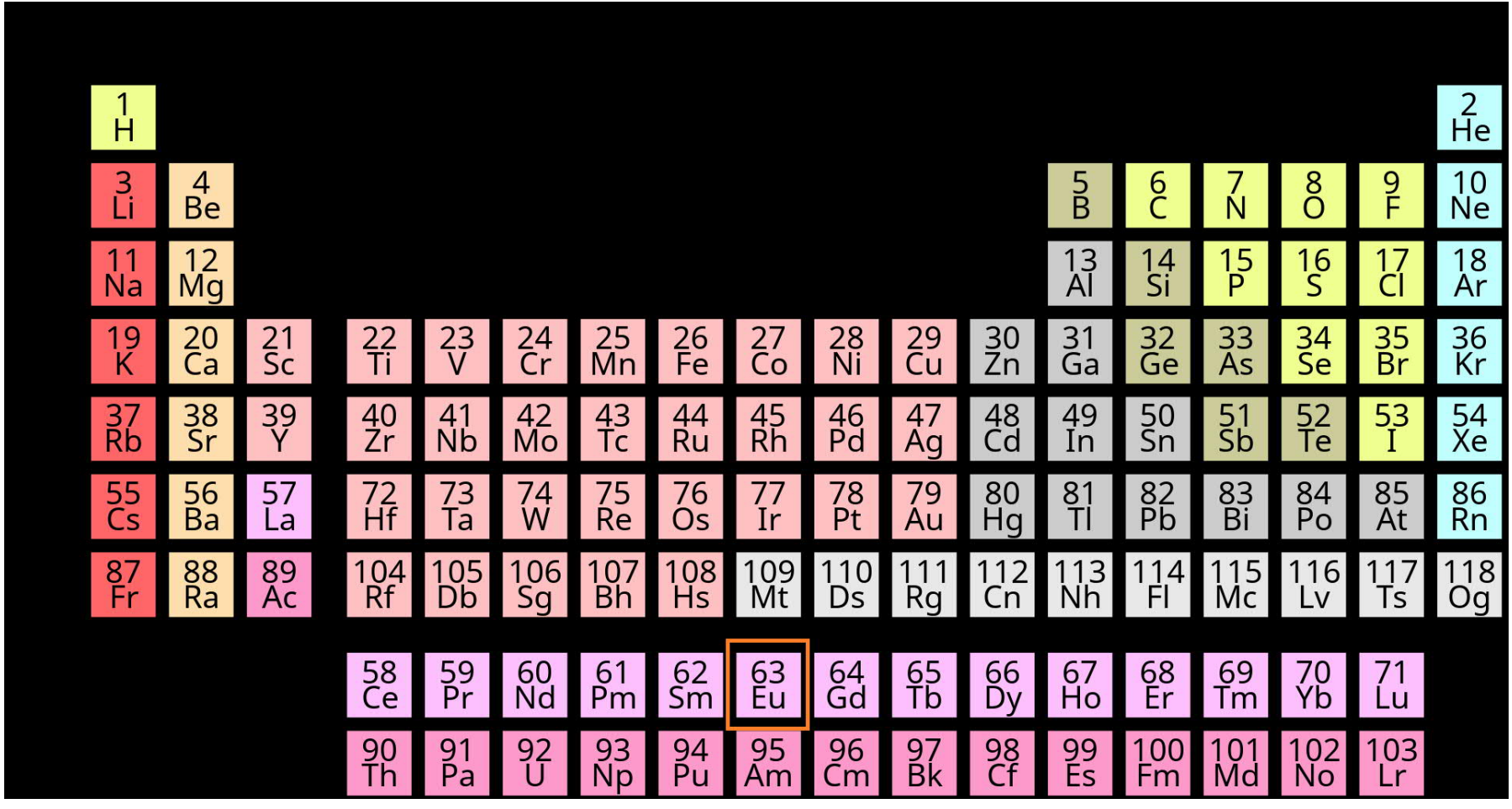
Abundancy and production

- Europium is the rarest element of the rare earth metals.
- The Rare Earth Metals are not actually very rare. They were discovered late and separating them was hard.
- Abundancy in Earth's crust 1-2.1 ppm.
- World reserves: 14 $*10^{11}$ kg.
- Most commonly found in bastnasite and monazite ores.
- Main mining areas of europium are China and USA.
- Reserves of europium are estimated to be around 150.000 tonnes and world production of the pure metal is around 100 tonnes a year.

Special features…

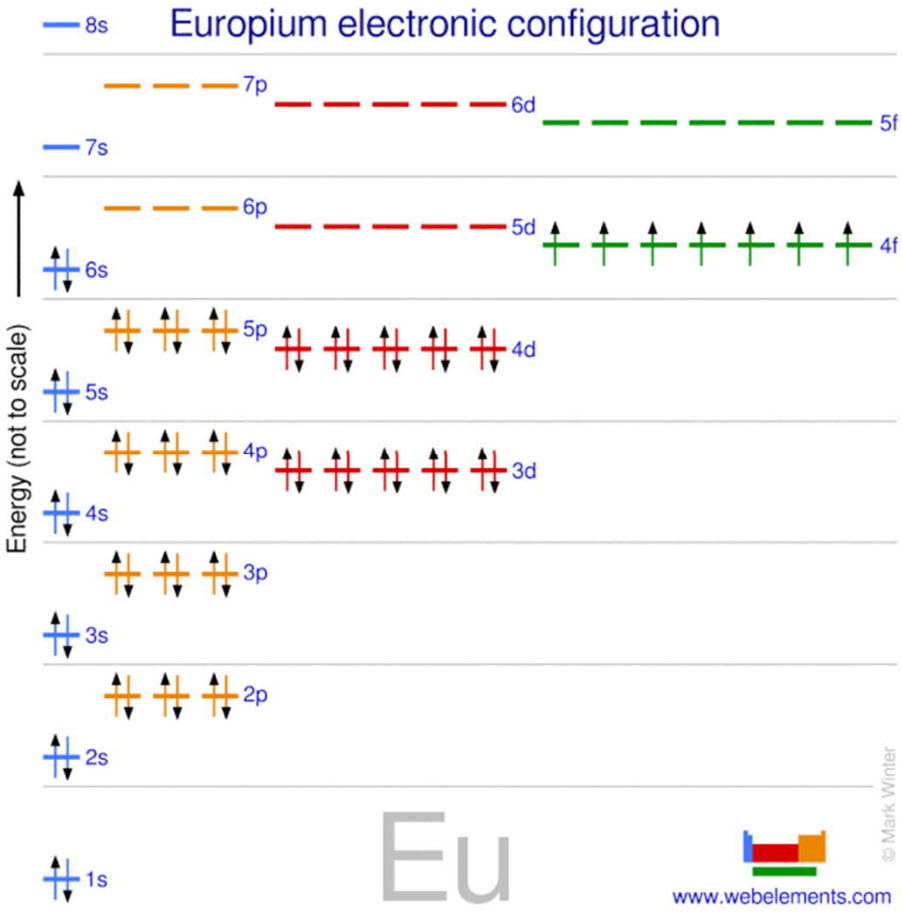
- Has two common oxidation states. +II oxidation state.
- Has a bright shiny surface but gets oxidized quickly when in contact with air.
- Europium complexes hold great potential as red-emitting and near-infrared emitting materials.

Chemistry and Compounds


1 H
2 He
3 Li
4 Be
5 B
6 C
7 N
8 O
9 F
10 Ne
11 Na
12 Mg
13 Al
14 Si
15 P
16 S
17 Cl
18 Ar
19 K
20 Ca
21 Sc
22 Ti
23 V
24 Cr
25 Mn
26 Fe
27 Co
28 Ni
29 Cu
30 Zn
31 Ga
32 Ge
33 As
34 Se
35 Br
36 Kr
37 Rb
38 Sr
39 Y
40 Zr
41 Nb
42 Mo
43 Tc
44 Ru
45 Rh
46 Pd
47 Ag
48 Cd
49 In
50 Sn
51 Sb
52 Te
53 I
54 Xe
55 Cs
56 Ba
57 La
72 Hf
73 Ta
74 W
75 Re
76 Os
77 Ir
78 Pt
79 Au
80 Hg
81 Tl
82 Pb
83 Bi
84 Po
85 At
86 Rn
87 Fr
88 Ra
89 Ac
104 Rf
105 Db
106 Sg
107 Bh
108 Hs
109 Mt
110 Ds
111 Rg
112 Cn
113 Nh
114 Fl
115 Mc
116 Lv
117 Ts
118 Og
58 Ce
59 Pr
60 Nd
61 Pm
62 Sm
63 Eu
64 Gd
65 Tb
66 Dy
67 Ho
68 Er
69 Tm
70 Yb
71 Lu
90 Th
91 Pa
92 U
93 Np
94 Pu
95 Am
96 Cm
97 Bk
98 Cf
99 Es
100 Fm
101 Md
102 No
103 Lr

Electron configuration, oxidation states

- +III and +II oxidation states are most common.
- 4f subshells stabilize the ion making the oxidation state +II possible for Europium.



Size and an examples of important compounds, their properties and applications

- Metal radius is 208.4 pm and ionic radius is about 95 nm.
- It forms a cubic, body centered crystal structure.
- Europium oxide (Eu_2O_3) is a common phosphor used in TV or mercury discharche lamps.

  → has an oxidation of +III and emits red light.

Specific functionalities

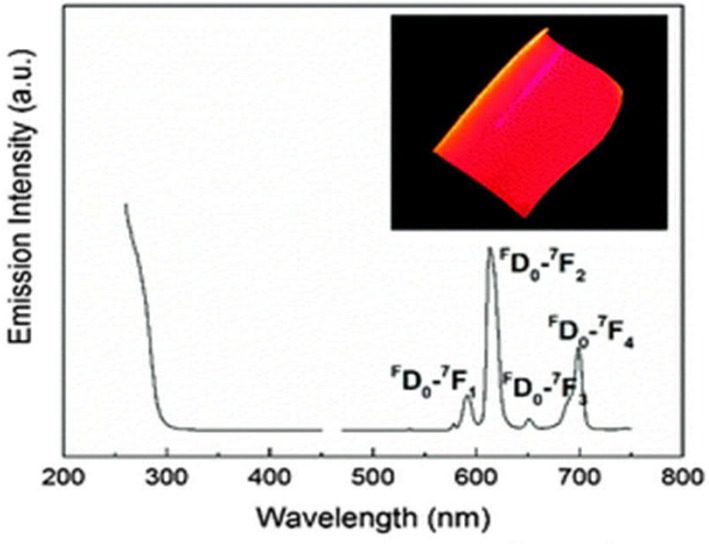
Flexible inorganic-organic thin film phosphors

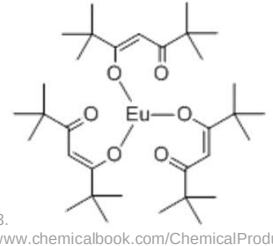
- Inorganic–organic europium-based hybrid materials have good luminescent properties.

- Eu-hybrid thin-film phosphors grown by ALD/MLD by Eu(thd)3 and 3,5-pyridinedicarboxylic acid as precursors could be exciting new phosphor materials in many applications.

  → flexible films or nanostructured films where thin coating needed.

- Emission intensity peak at about 615 nm.





Eu(thd)3. https://www.chemicalbook.com/ChemicalProductProperty_EN_CB1437304.htm

Giedraityte Z., Sunberg P., Karppinen, M., 2015. Flexible inorganic-organic thin film phosphors by ALD/MLD. J.Mater.Chem. 3, 12316. DOI: 10.1039/c5tc03201f.

Near-infrared emitting phosphor

- **Discovery of broadband-emitting NIR light sources is a necessary and urgent requirement.**

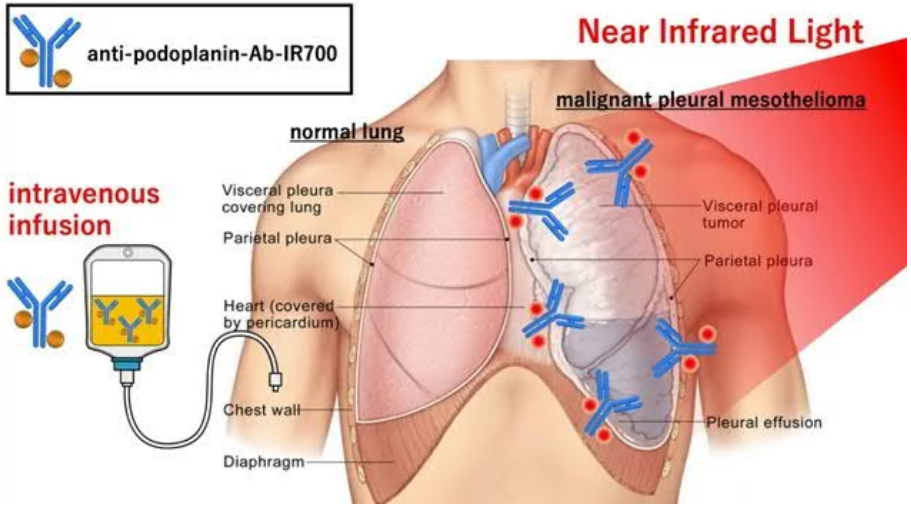
  → broad full-width at half maximum (FWHM)

- **Eu2+-activated phosphors normally possess high efficiency and have been applied in the field of commercial white LEDs.**
- **Ca3Sc2Si3O12:Eu2+ achieves a peak beyond 700 nm but can not be pumped by blue light.**

Qiao J., Zhou, G., Zhou Y., Zhang Q., XIa Z., 2019. Divalent europium-doped near-infrared-emitting phosphor for light-emitting diodes. Nature Communications 10:5267. Doi: | https://doi.org/10.1038/s41467-019-13293-0.

- **K3LuSi2O7:Eu2+ gives a broad emission band centered at 740 nm by a 460 nm blue light excitation.**

- **Eu2+ phosphors can be used in night-vision technologies, and other fields such as medical and food industries.**



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Thank you!