superconductors

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What are the superconductors

A superconductor is a material, generally a inter metallic alloy that can conduct electricity or transport electrons from one atom to another with no resistance. This means no heat, sound or any other form of energy would be released from the material when it has reached "critical temperature" (T_c), or the temperature at which the material becomes superconductive.

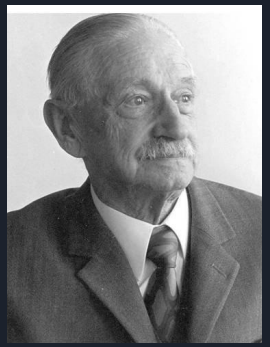
Brief History, The begining

In 1911 superconductivity was first observed in mercury by Dutch physicist Heike Kamerlingh Onnes of Leiden University . When he cooled it to the temperature of liquid helium, 4 degrees Kelvin (-452F, -269C), its resistance suddenly disappeared

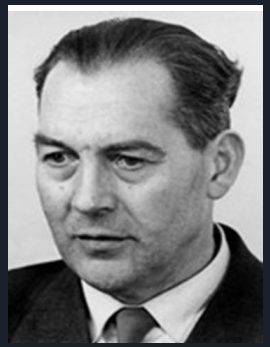
The next great step

in 1933 German researchers Walther Meissner and Robert Ochsenfeld discovered that a superconducting material will repel a magnetic field. A magnet moving by a conductor induces currents in the conductor.

Walther Meissner



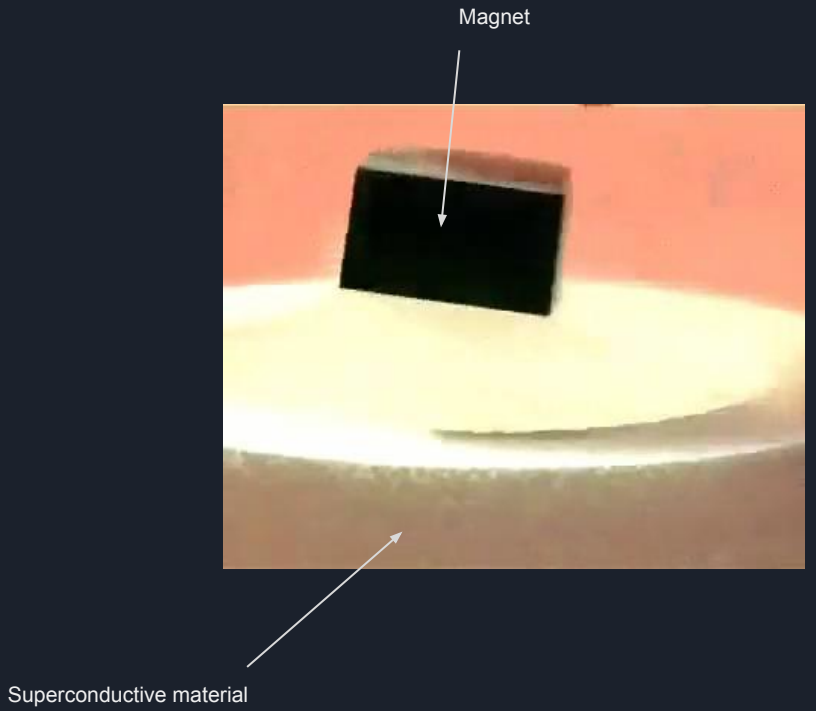
Robert Ochsenfeld



In a superconductor the induced currents exactly mirror the field that would have otherwise penetrated the superconducting material - causing the magnet to be repulsed.

"Meissner effect"

This phenomenon is known as strong diamagnetism also referred as the "Meissner effect". The Meissner effect is so strong that a magnet can actually be levitated over a superconductive material.



Superconductors come in two different flavors: type I and type II

(1)

The Type 1 category of superconductors is mainly comprised of metals and metalloids that show *some* conductivity at room temperature. They require incredible cold to slow down molecular

(2)

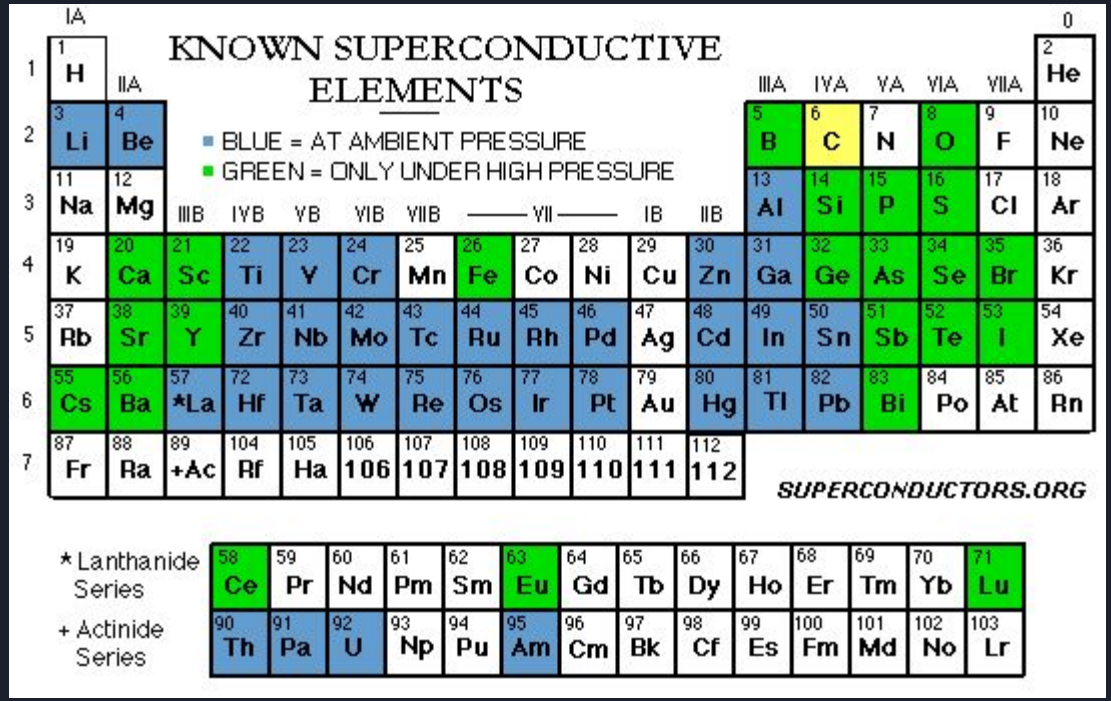
Except for the elements vanadium, technetium and niobium, the Type 2 category of superconductors is comprised of metallic compounds and alloys. The recently-discovered superconducting "perovskites" (metal-oxide ceramics that normally have a ratio of 2 metal atoms to every 3 oxygen atoms) belong to this Type 2 group.

Type 1

Type 1 superconductors - characterized as the "soft" superconductors - were discovered first and require the coldest temperatures to become superconductive. They exhibit a very sharp transition to a superconducting state (see above graph) and "perfect" diamagnetism - the ability to repel a magnetic field completely. Below is a list of known Type 1 superconductors along with the critical transition temperature (known as Tc) below which each superconductor. The 3rd column gives the lattice structure of the solid that produced the noted Tc. Surprisingly, copper, silver and gold, three of the best metallic conductors, do not rank among the superconductive elements.

Type 2

Type 2 superconductors - also known as the "hard" superconductors - differ from Type 1 in that their transition from a normal to a superconducting state is gradual across a region of "mixed state" behavior. Since a Type 2 will allow *some* penetration by an external magnetic field into its surface, this creates some rather novel mesoscopic phenomena like superconducting "stripes" and "flux-lattice vortices". While there are far too many to list in totality, some of the more interesting Type 2 superconductors are listed below by similarity and with descending Tc's. Where available, the lattice structure of the system is also noted.


KNOWN SUPERCONDUCTIVE ELEMENTS
BLUE = AT AMBIENT PRESSURE
GREEN = ONLY UNDER HIGH PRESSURE
IA
IIA
IIIB
IVB
VB
VIB
VIIB
VII
IB
IIB
IIIA
IVA
VA
VIA
VIIA
0
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 Ha
106 106
107 107
108 108
109 109
110 110
111 111
112 112
SUPERCONDUCTORS.ORG
* Lanthanide Series
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
+ Actinide Series
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

Applications

- Magnetic-levitation is an application where superconductors perform extremely well.
- low-loss power cables
- powerful superconducting electromagnets used in maglev trains, magnetic resonance imaging (MRI) and Nuclear magnetic resonance (NMR) machines, magnetic confinement fusion reactors, and the beam-steering and focusing magnets used in particle accelerators.
- the production of sensitive magnetometers based on SQUIDs

References

http://ffden-2.phys.uaf.edu/113.web.stuff/travis/what_is.html#1

http://www.superconductors.org/INdex.htm

https://www.reddit.com/r/gifs/comments/1q0d8n/the_meissner_effect/

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