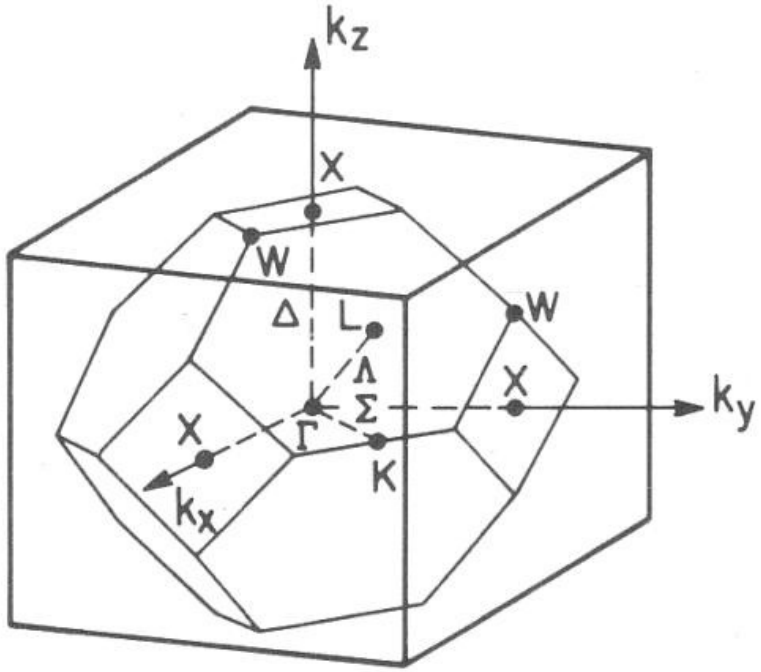
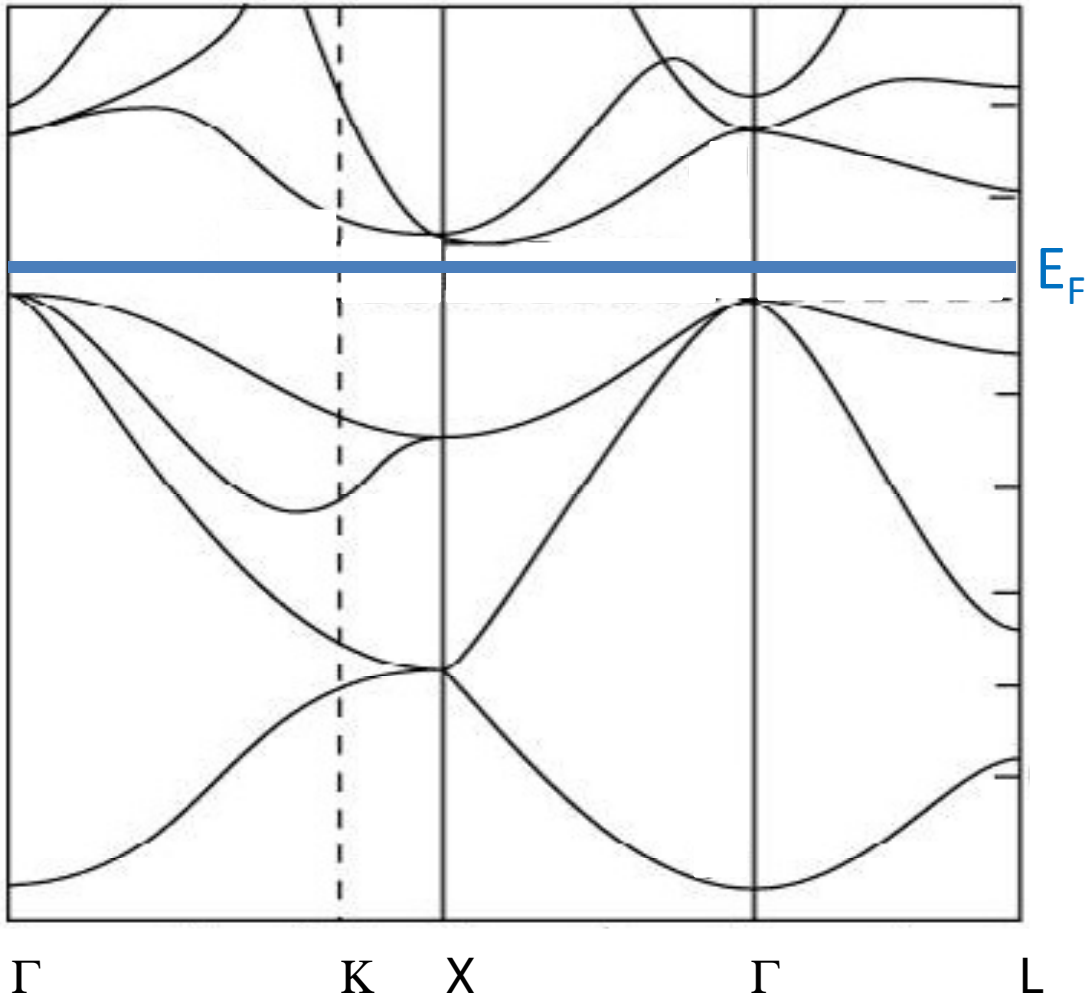
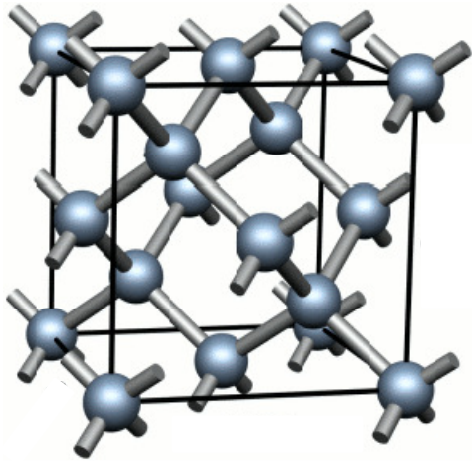
Slides
Condensed Matter Physics
Lecture 16

Silicon = FCC with a 2-atom basis

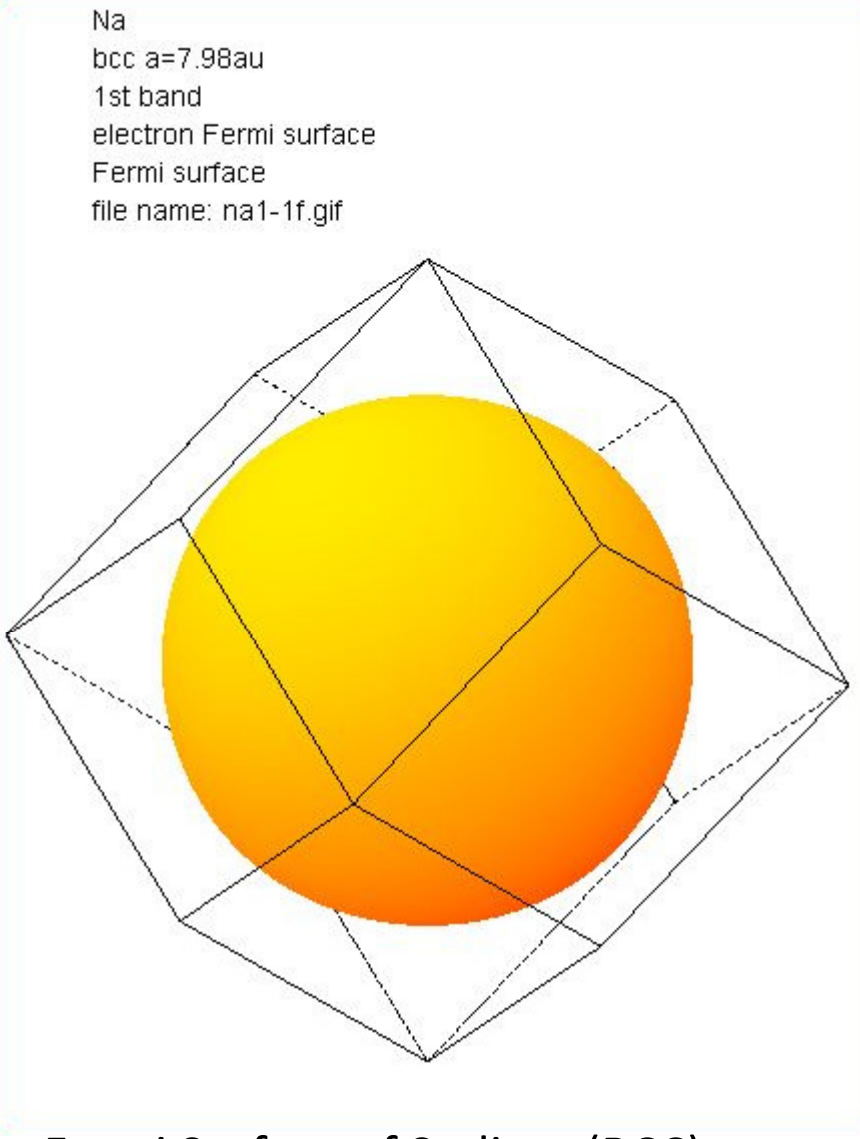
Si @ [0,0,0] and Si @ [¼, ¼, ¼]



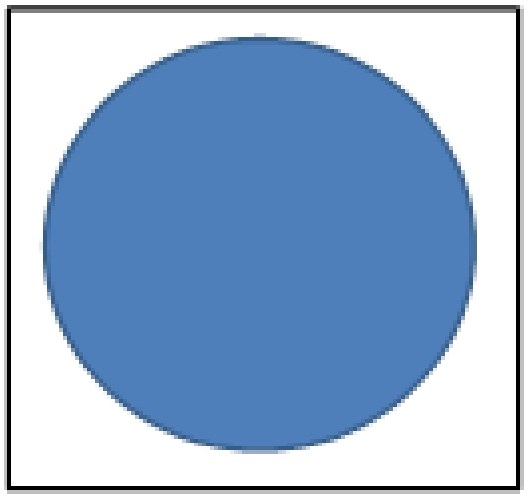




Si has valence = 4



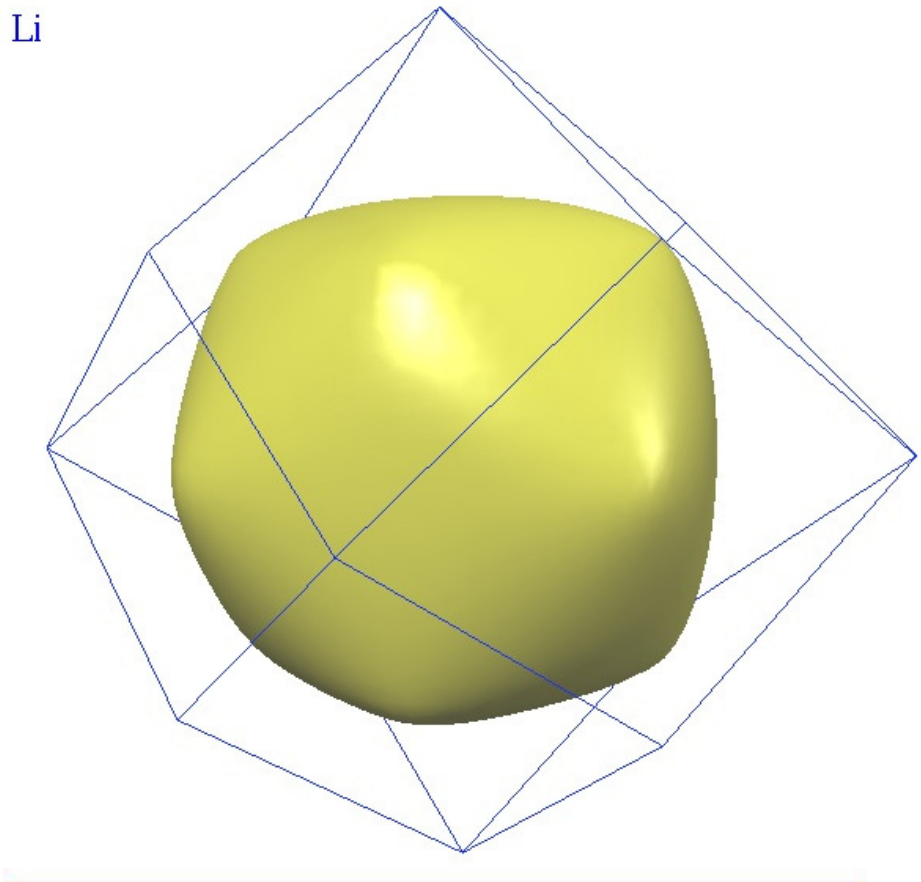
Fermi Surface of Sodium (BCC)

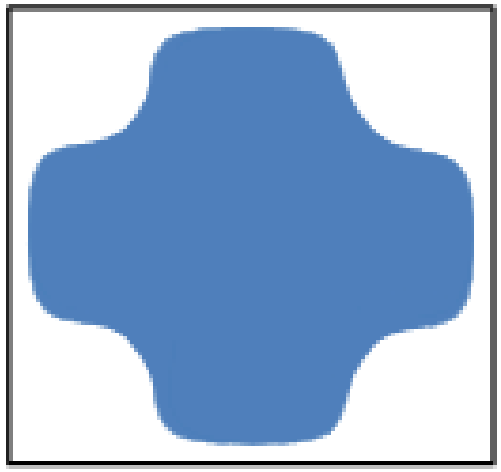


2d analogue

Monovalent = Half-Filled Brillouin Zone

Li
bcc a=6.59au
1st band
electron Fermi surface
Fermi surface
file name: li1-1f.gif

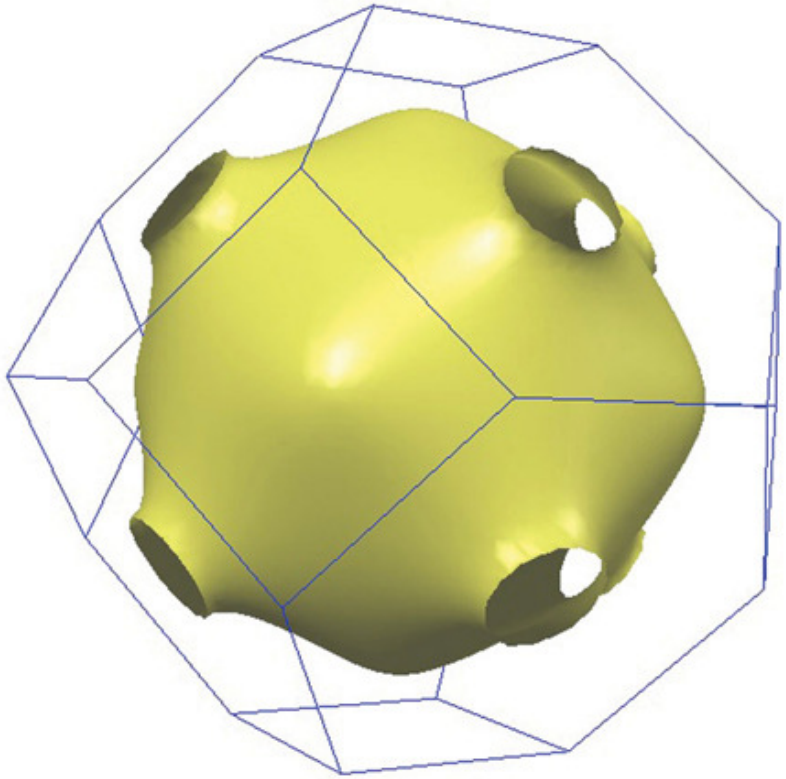




2d analogue

Fermi Surface of Lithium (BCC)

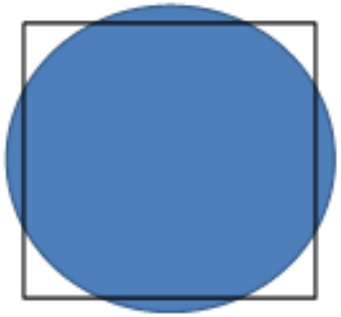
Monovalent = Half-Filled Brillouin Zone



2d analogue

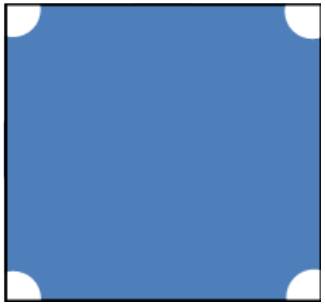
Fermi Surface of Copper (FCC)

Monovalent = Half-Filled Brillouin Zone

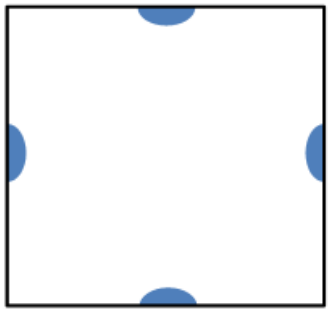


No periodic
Potential
Divalent=
Enough electrons
To fill 1st zone

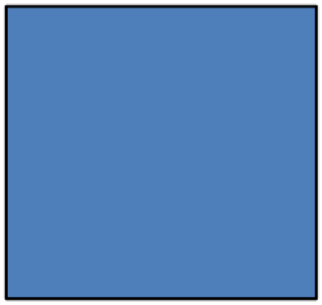
with weak periodic
potential



weak potential
Lowest Band
(in 1st BZ)

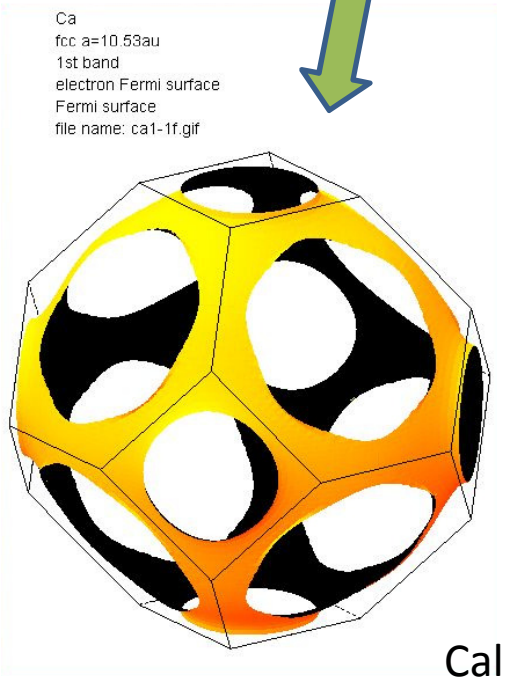


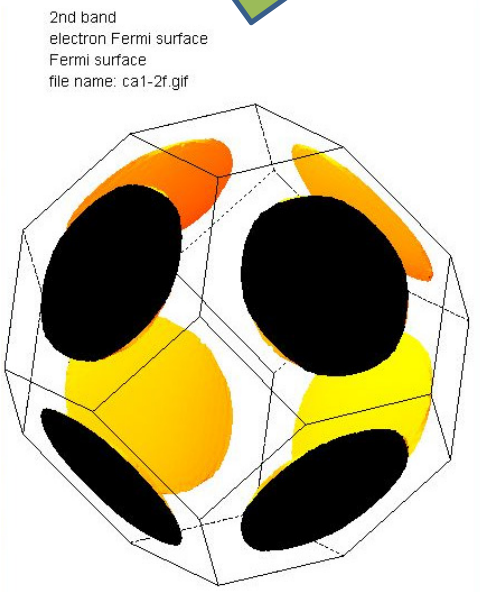
2nd band



with strong periodic
potential – 1st BZ exactly
filled (insulator)

Analogues

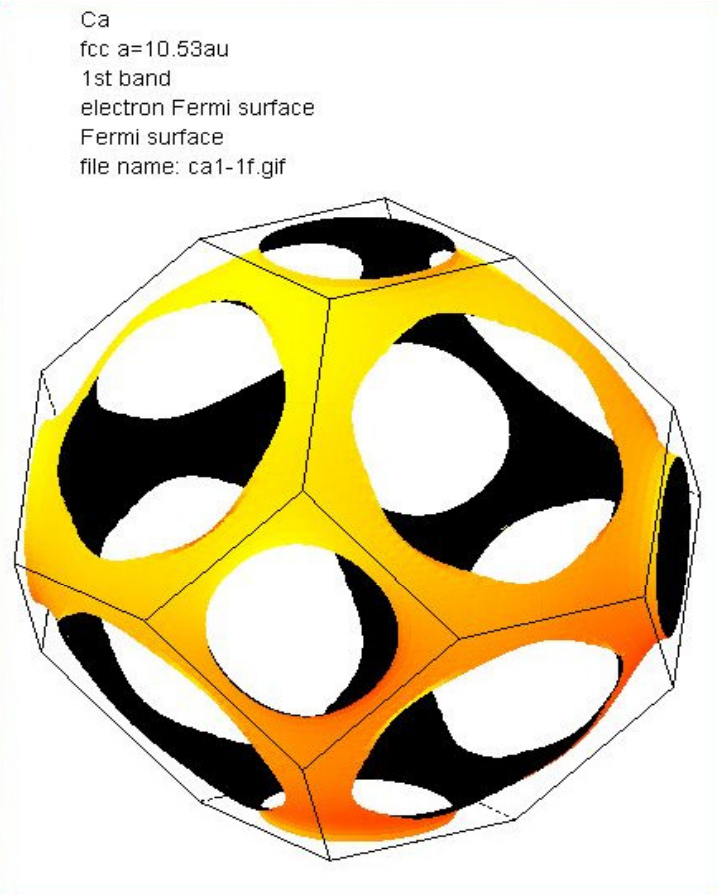




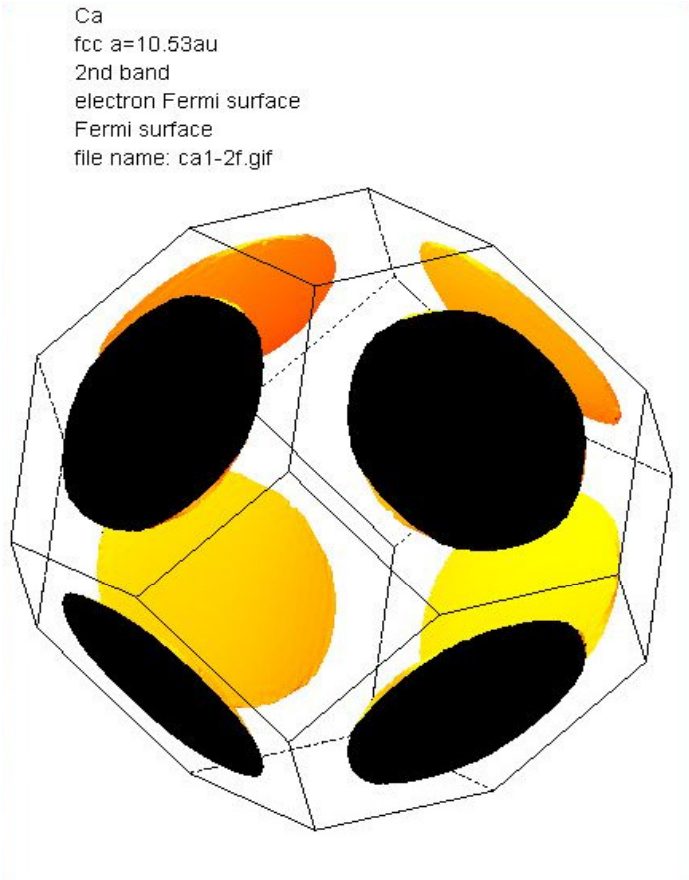
1st band

Calcium FCC
(Divalent)

2nd band



1st band



2nd band

Calcium FCC
(Divalent)

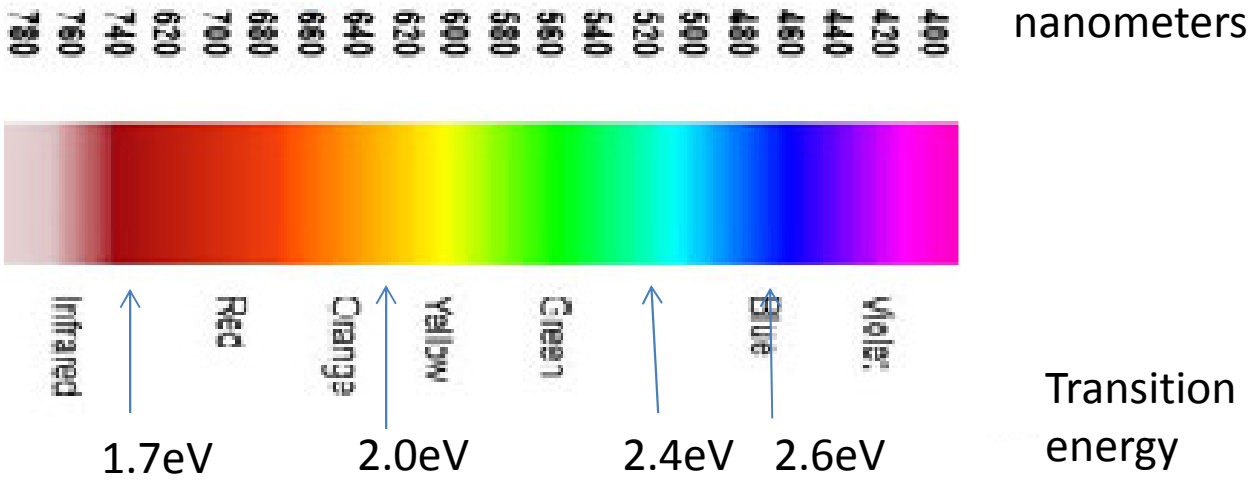
Cinnabar (HgS)
Gap = 2.0 eV

Realgar (As_4S_4)

Gap = 2.4eV

Sulfur

Gap = 2.6eV



Hope Diamond (Blue)
Roughly 1 Boron impurity per 10^7 carbon.

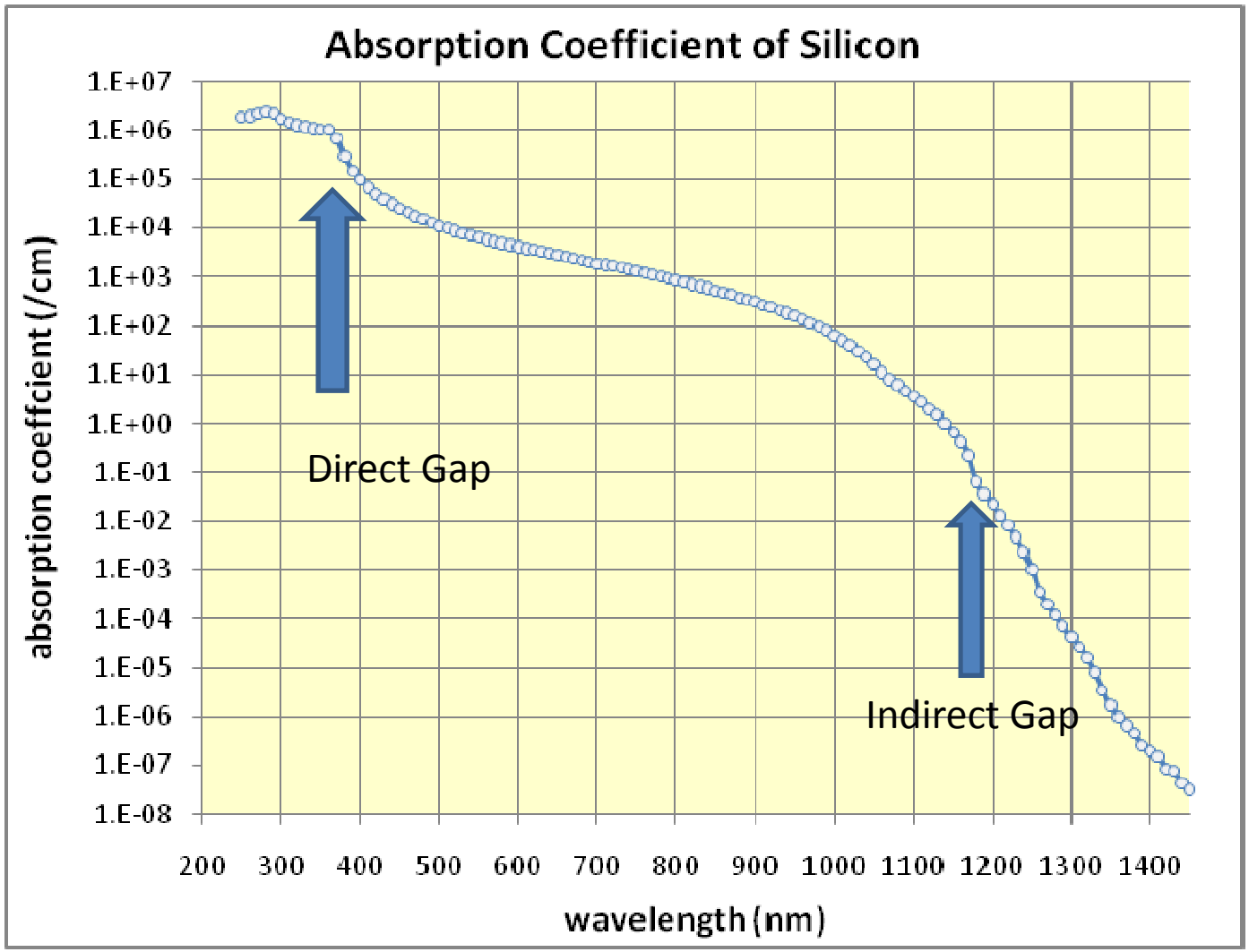
Estimated current value = 250 Million $

Tiffany Diamond (Yellow)
Roughly 1 Nitrogen impurity per 10^6 carbon.

Estimated value 12 Million$ (1983)

Synthetic Diamonds =

"Cheap" and any impurities you want. (this example is clear meaning no impurities)


Absorption Coefficient of Silicon
absorption coeffcient (/cm)
1.E+07
1.E+06
1.E+05
1.E+04
1.E+03
1.E+02
1.E+01
1.E+00
1.E-01
1.E-02
1.E-03
1.E-04
1.E-05
1.E-06
1.E-07
1.E-08
Direct Gap
Indirect Gap
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
wavelength (nm)

Freshly cut sodium