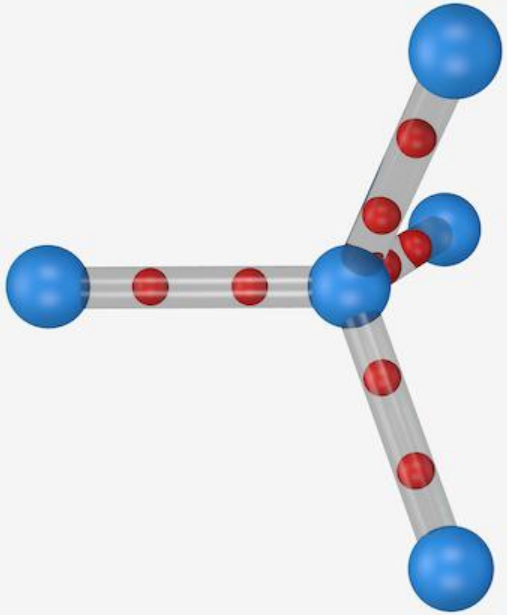
Working Principle of a Semiconductor Based Solar Cell

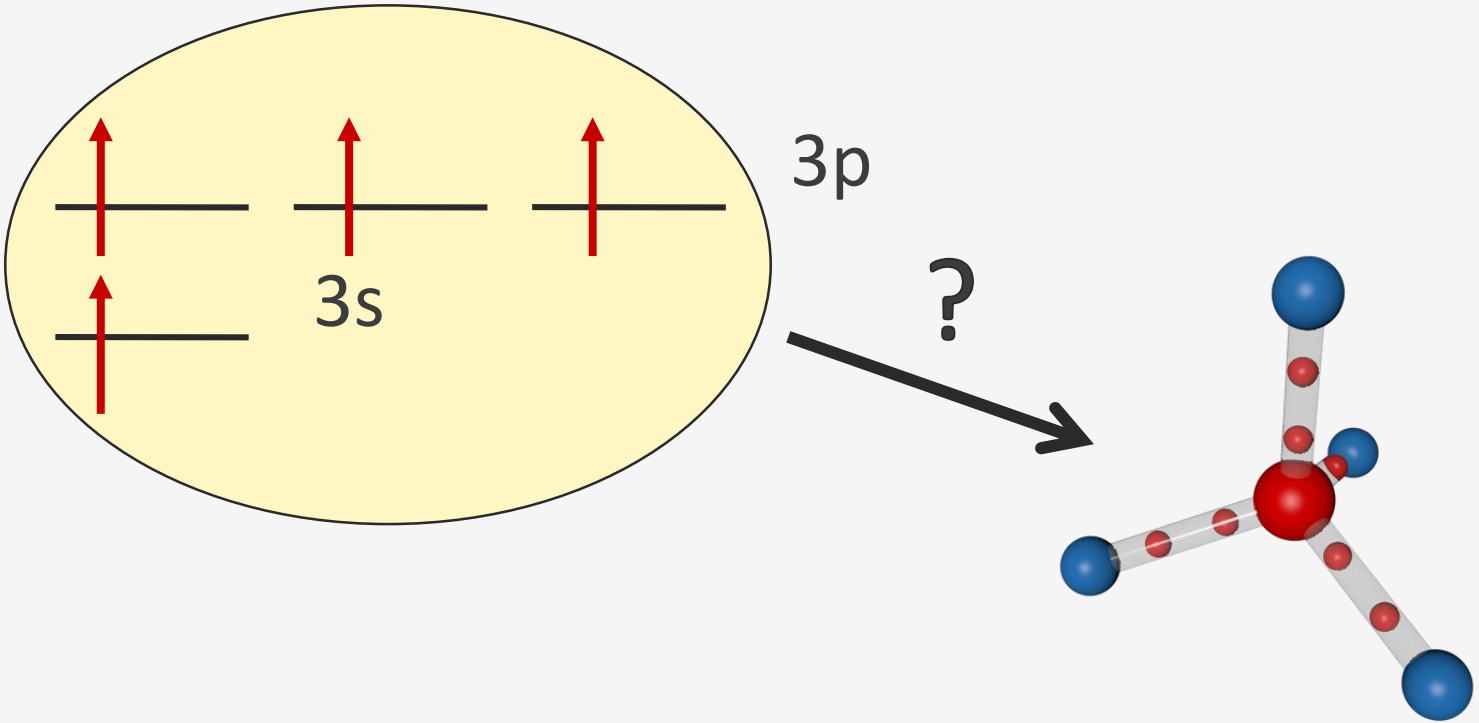
Band Gap II - Electrons in Molecular Bonds

Week 2.2.2

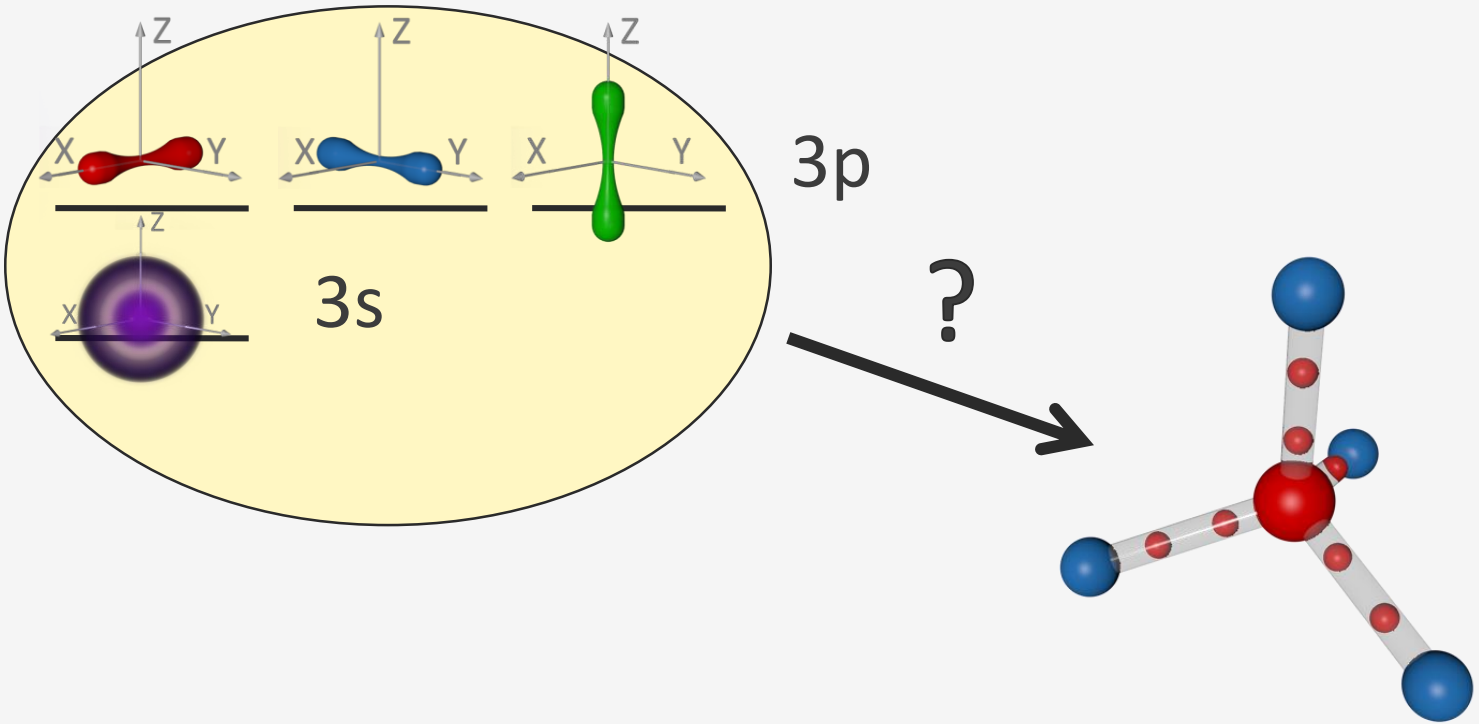
Arno Smets

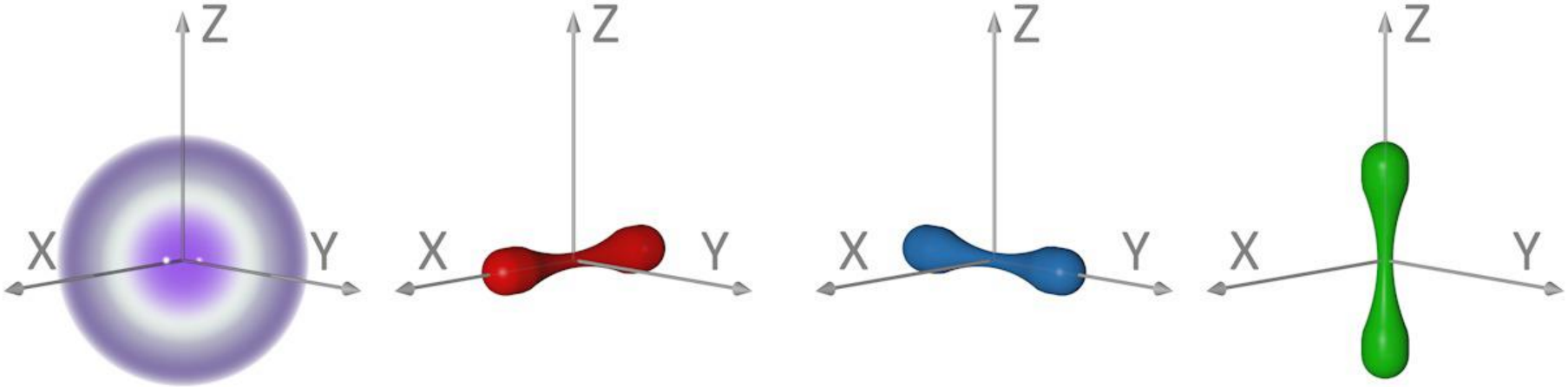


Bonding of electrons in Si network



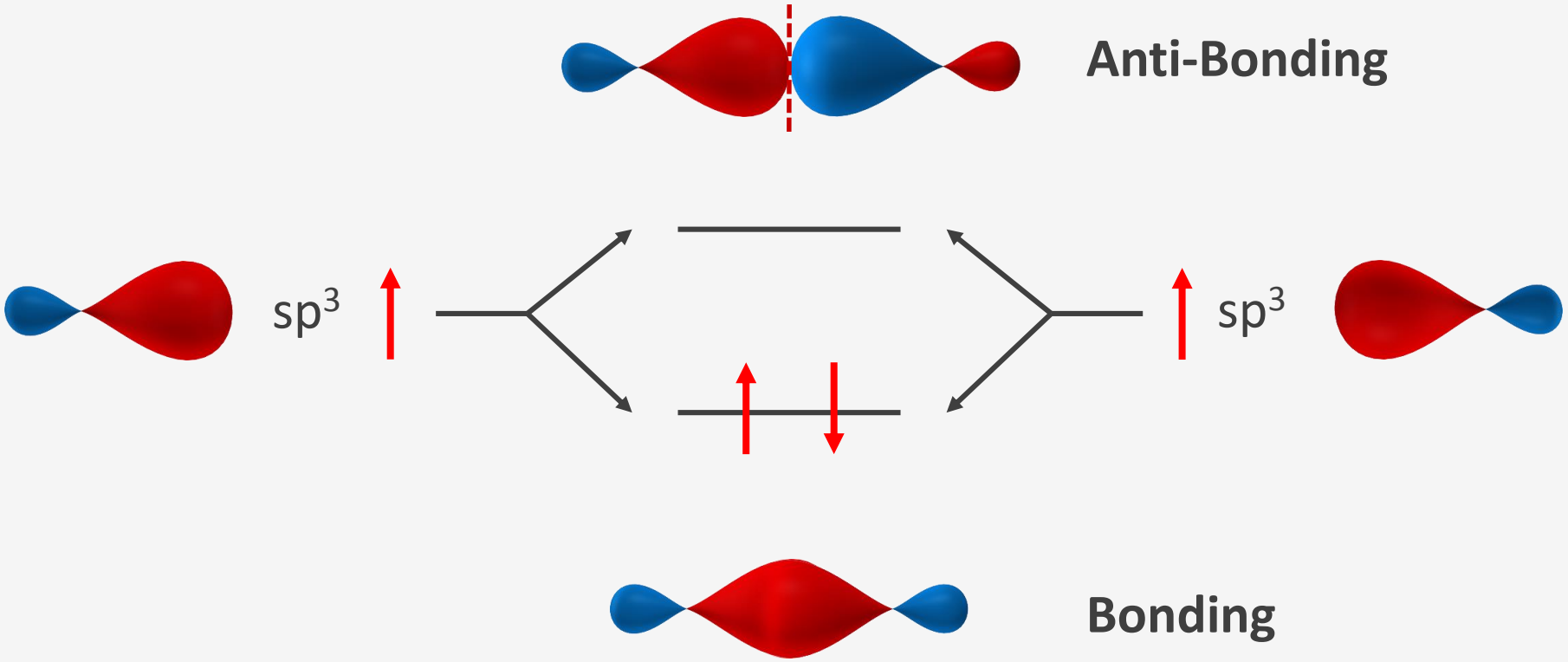
Bonding of electrons in Si network



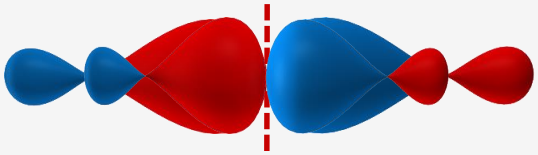


S Px Py Pz

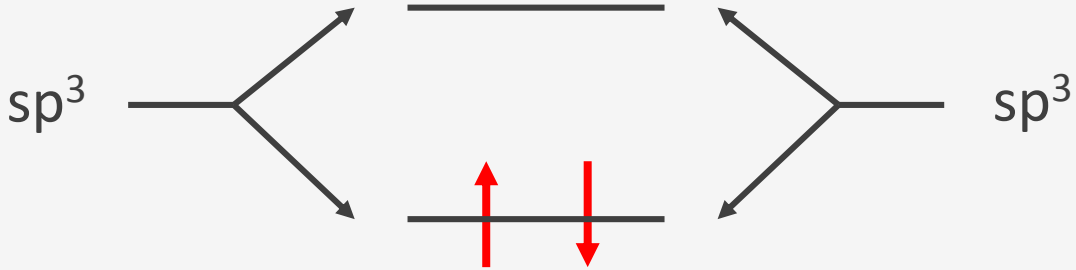
Molecular description of band gap



Molecular description of band gap

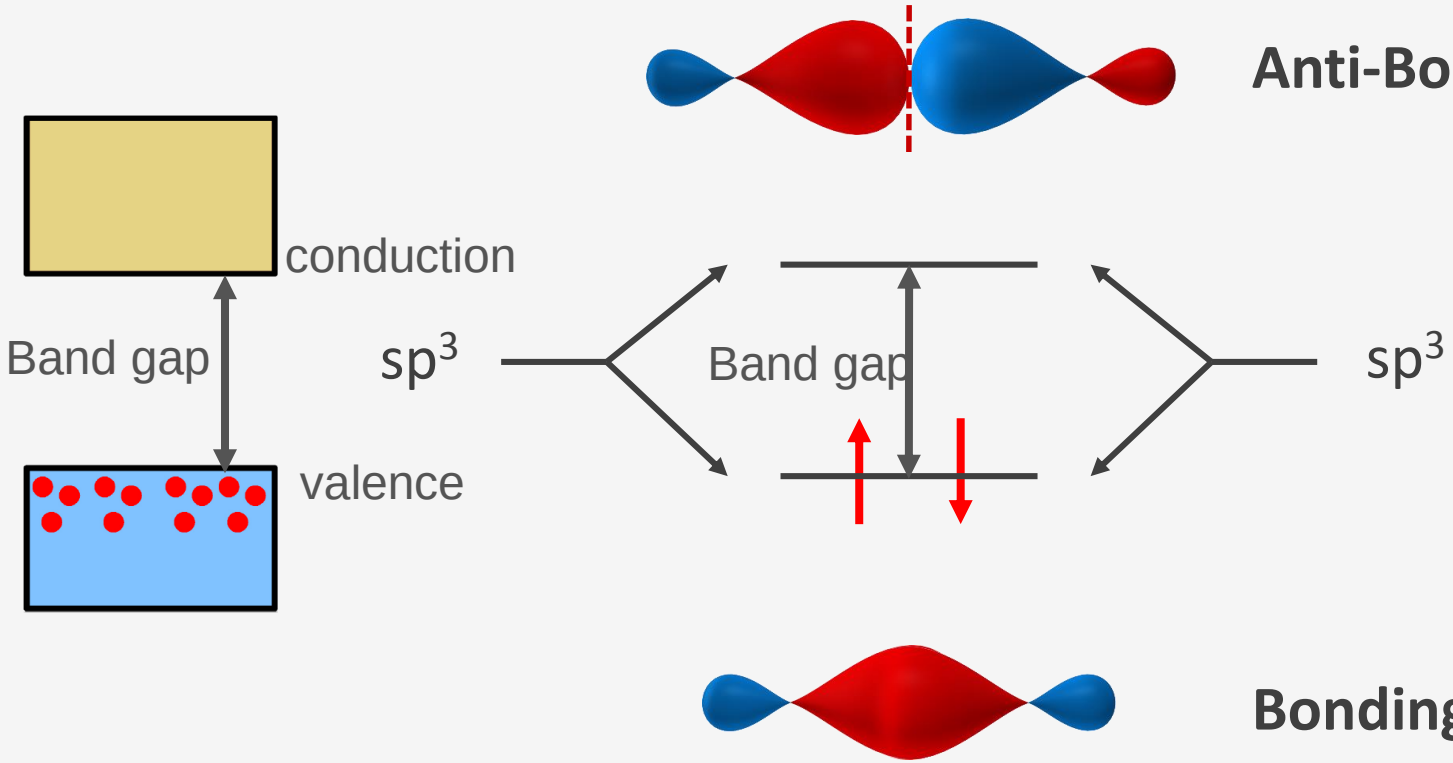


Anti-Bonding

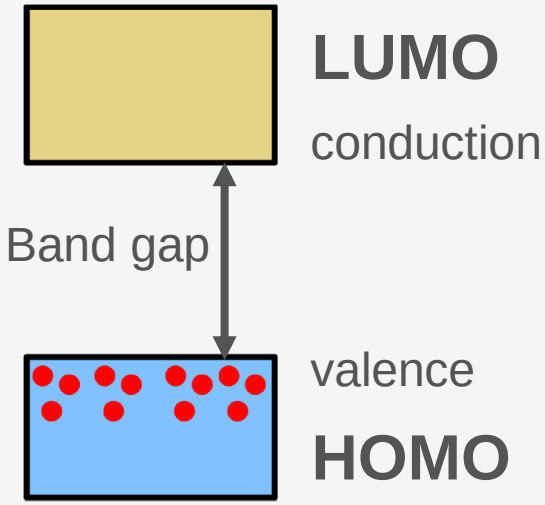


Bonding

Molecular description of band gap



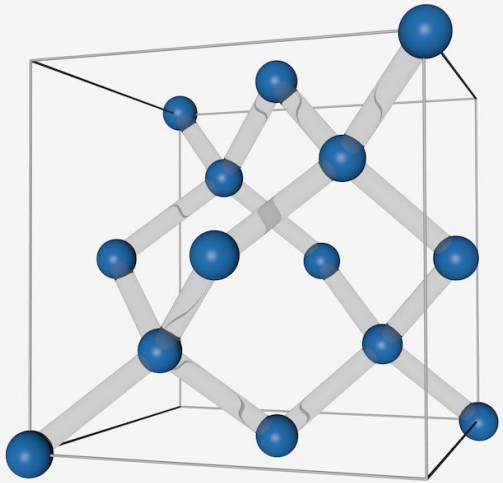
Molecular description of band gap



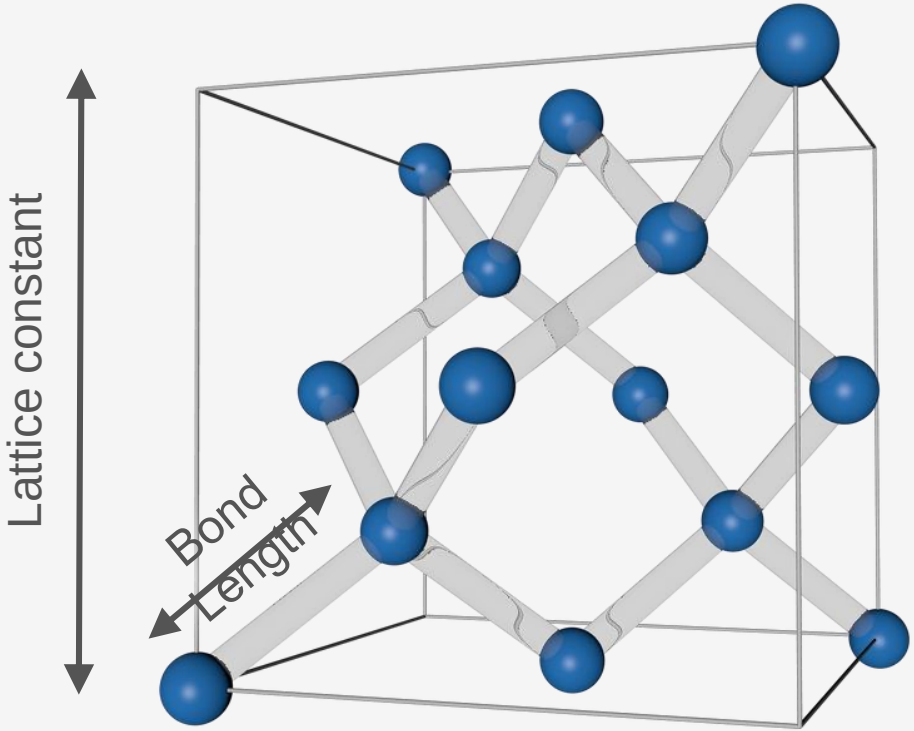
Semiconductor Materials

IV semiconductors: Si, Ge

		IIIA	IVA	VA	VIA	VIIA	VIIIA
							2 He 4.0026
		5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
IB	IIB	13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.065	17 Cl 35.453	18 Ar 39.948
29 Cu 63.546	30 Zn 65.38	31 Ga 69.723	32 Ge 72.64	33 As 74.922	34 Se 78.96	35 Br 79.904	36 Kr 83.798
47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po [209]	85 At [210]	86 Rn [222]

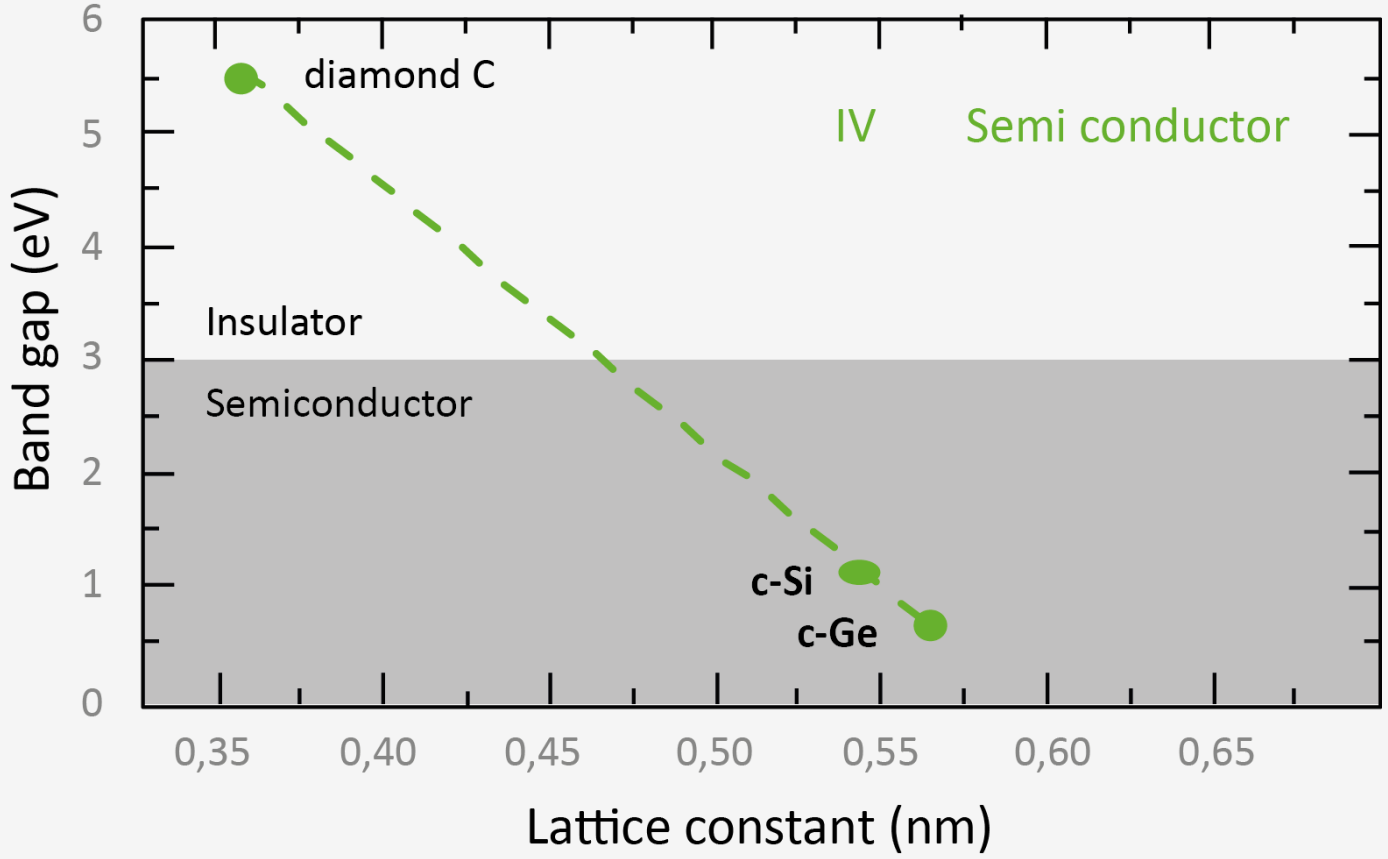


Carbon, silicon and Germanium



Lattice constant
=

$$\frac{4}{\sqrt{3}} \times$$ Bond Length


Band gap (eV)
6
5
4
3
2
1
0
diamond C
IV
Semi conductor
Insulator
Semiconductor
c-Si
c-Ge
0,35
0,40
0,45
0,50
0,55
0,60
0,65
Lattice constant (nm)

Semiconductor Materials

IV semiconductors: Si, Ge

III-V semiconductors:

IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
							2 He 4.0026
		5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
		13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.065	17 Cl 35.453	18 Ar 39.948
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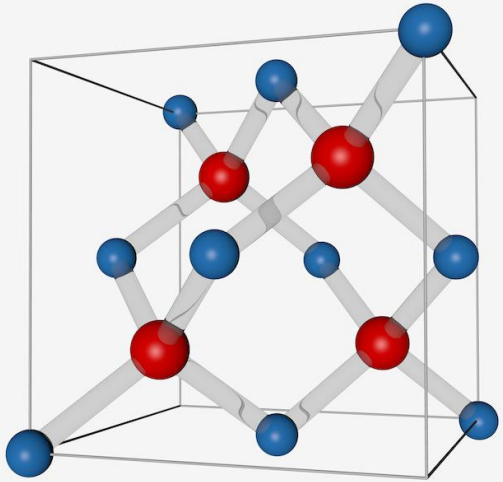
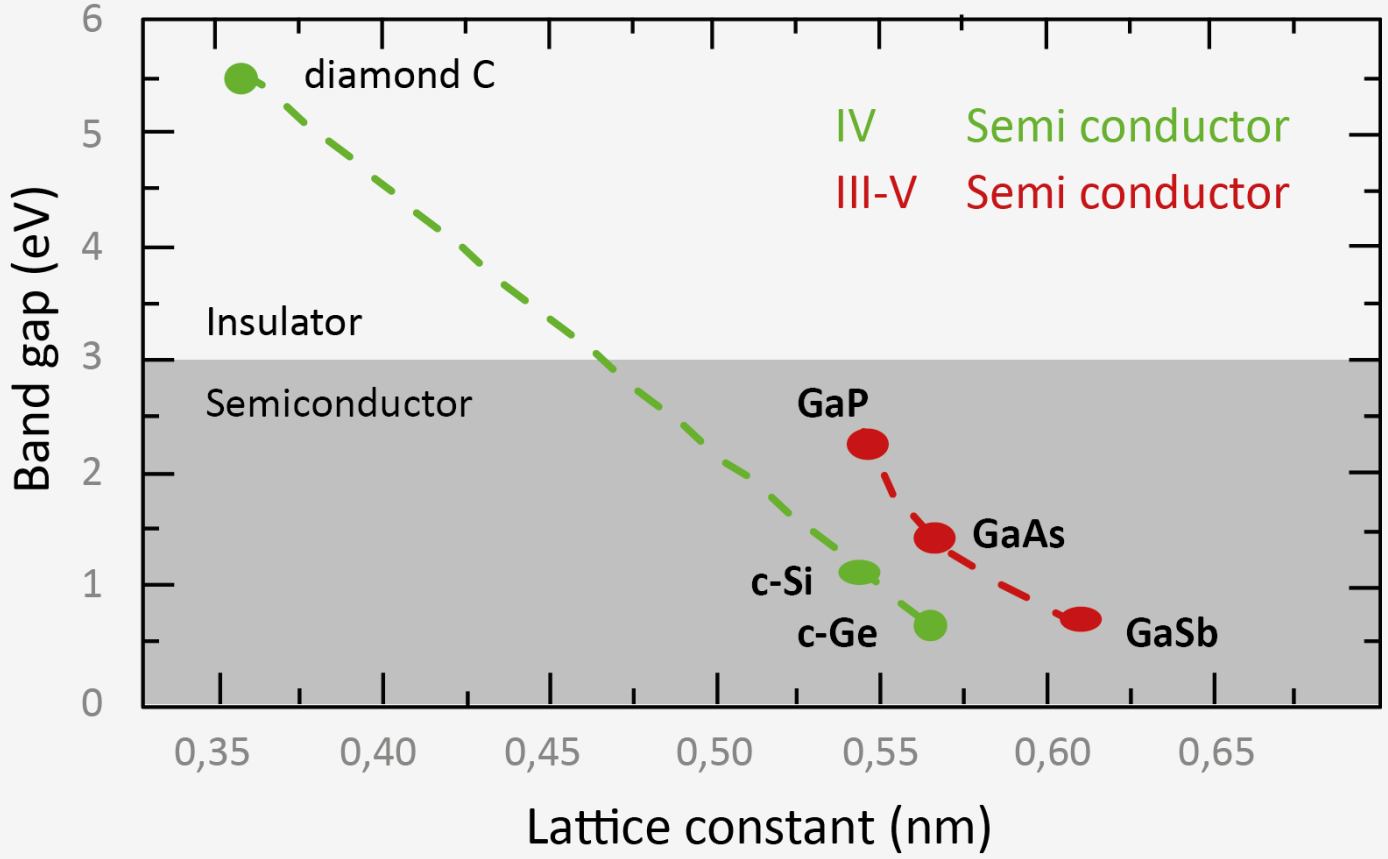
GaAs:




Band gap (eV)
6
5
4
3
2
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0
diamond C
IV Semi conductor
III-V Semi conductor
Insulator
Semiconductor
GaP
GaAs
c-Si
c-Ge
GaSb
0,35
0,40
0,45
0,50
0,55
0,60
0,65
Lattice constant (nm)

Semiconductor Materials

IV semiconductors: Si, Ge

III-V semiconductors:

II-VI semiconductors

IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
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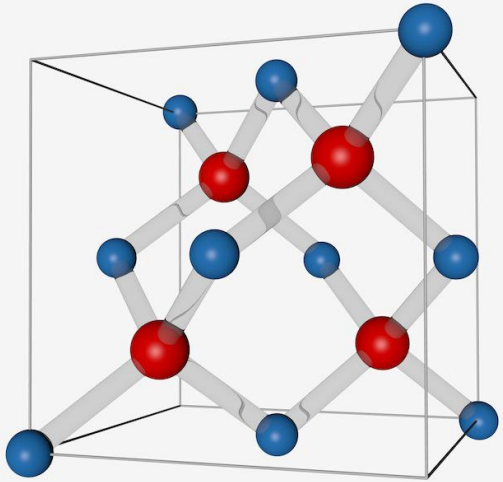
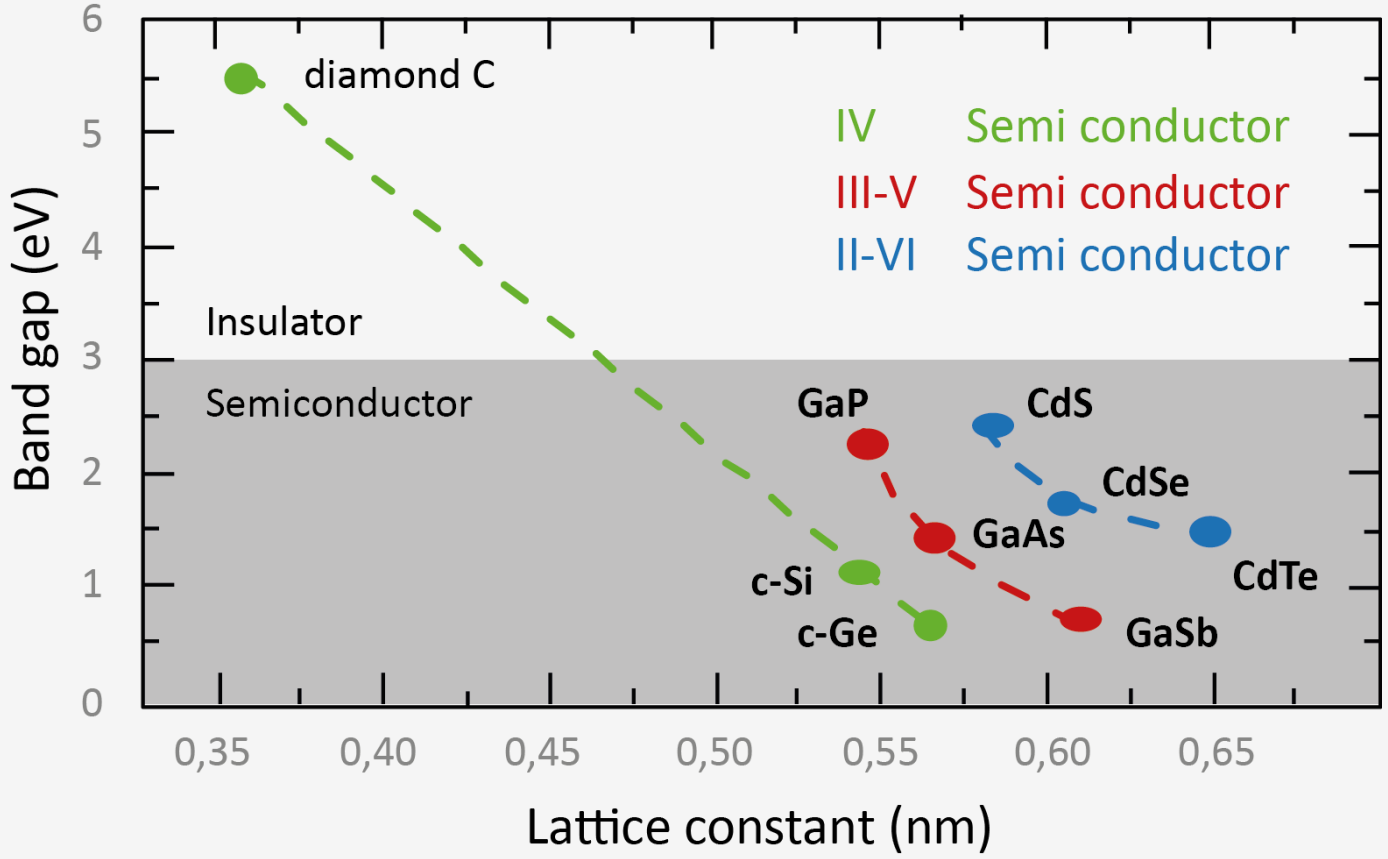
GaAs:

CdTe:




Band gap (eV)
6
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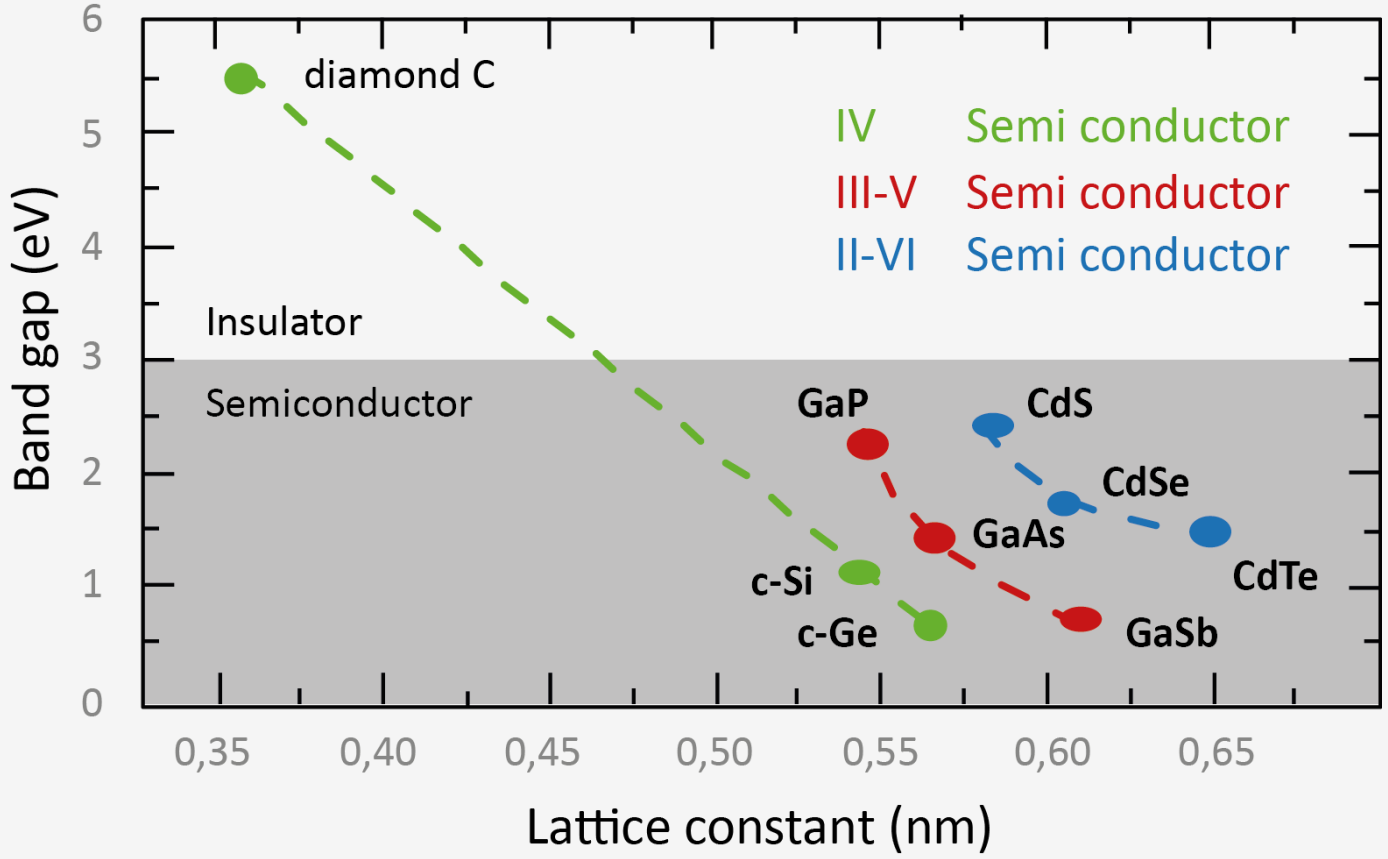
4
3
2
1
0
diamond C
IV Semi conductor
III-V Semi conductor
II-VI Semi conductor
Insulator
Semiconductor
GaP
CdS
CdSe
GaAs
CdTe
c-Si
c-Ge
GaSb
0,35
0,40
0,45
0,50
0,55
0,60
0,65
Lattice constant (nm)


Band gap (eV)
6
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II-VI Semi conductor
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GaSb
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0,60
0,65
Lattice constant (nm)