Metallic bonding

Metallic crystals

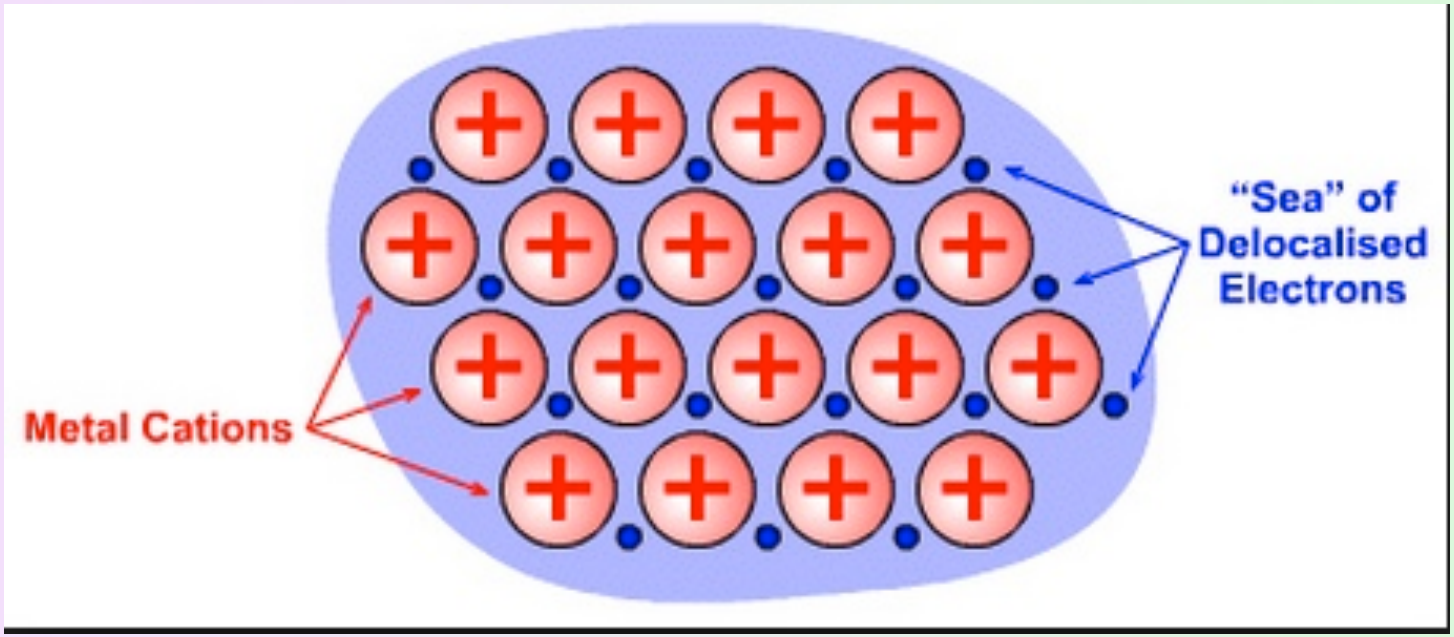
lattice points occupied by metal atoms

nuclei and core electrons occupy lattice sites, valence electrons move throughout the lattice

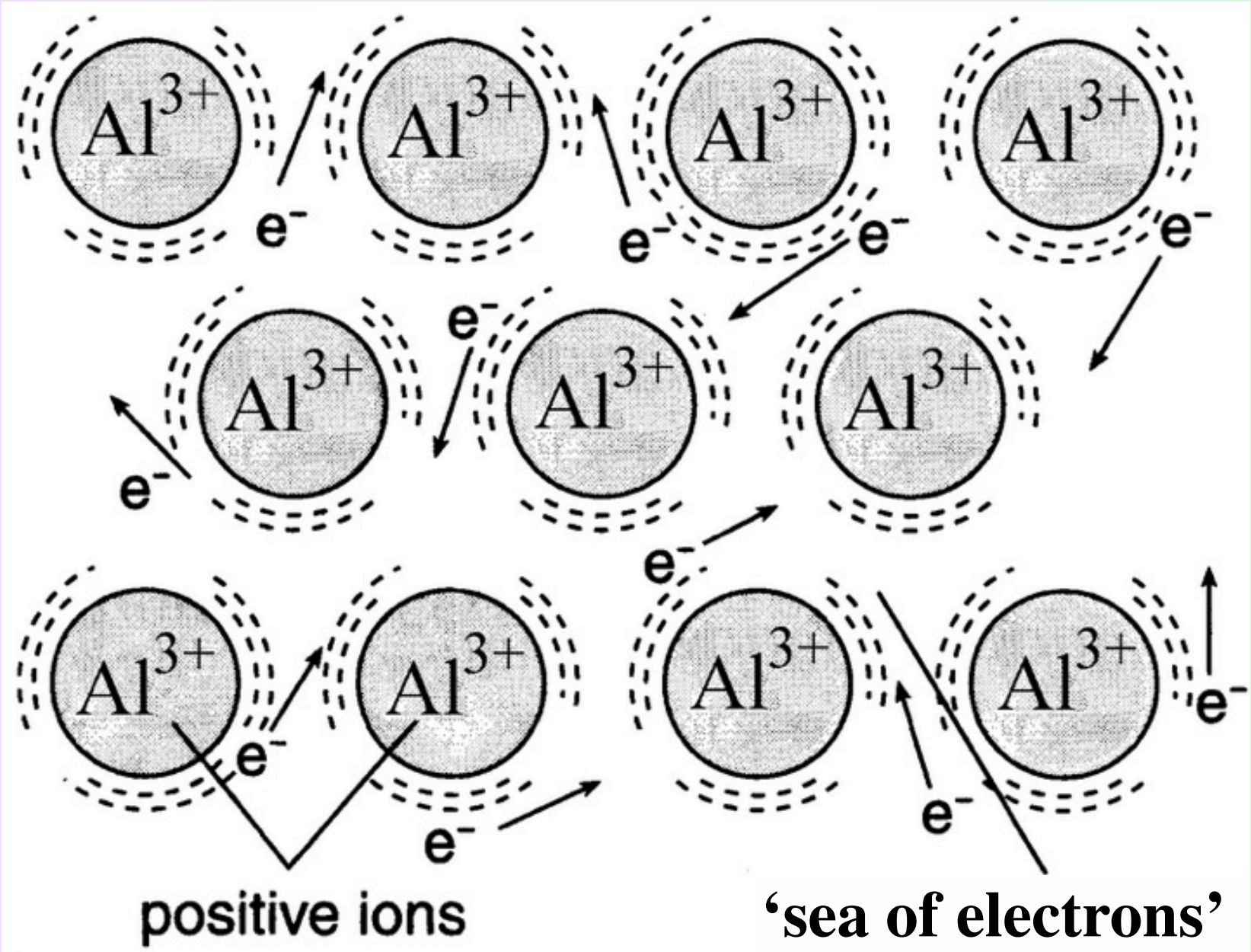
electrons delocalized over many, if not all, atoms in the lattice

metal atoms are difficult to separate from one another but can be moved relative to each other

Metallic crystals (simple model)

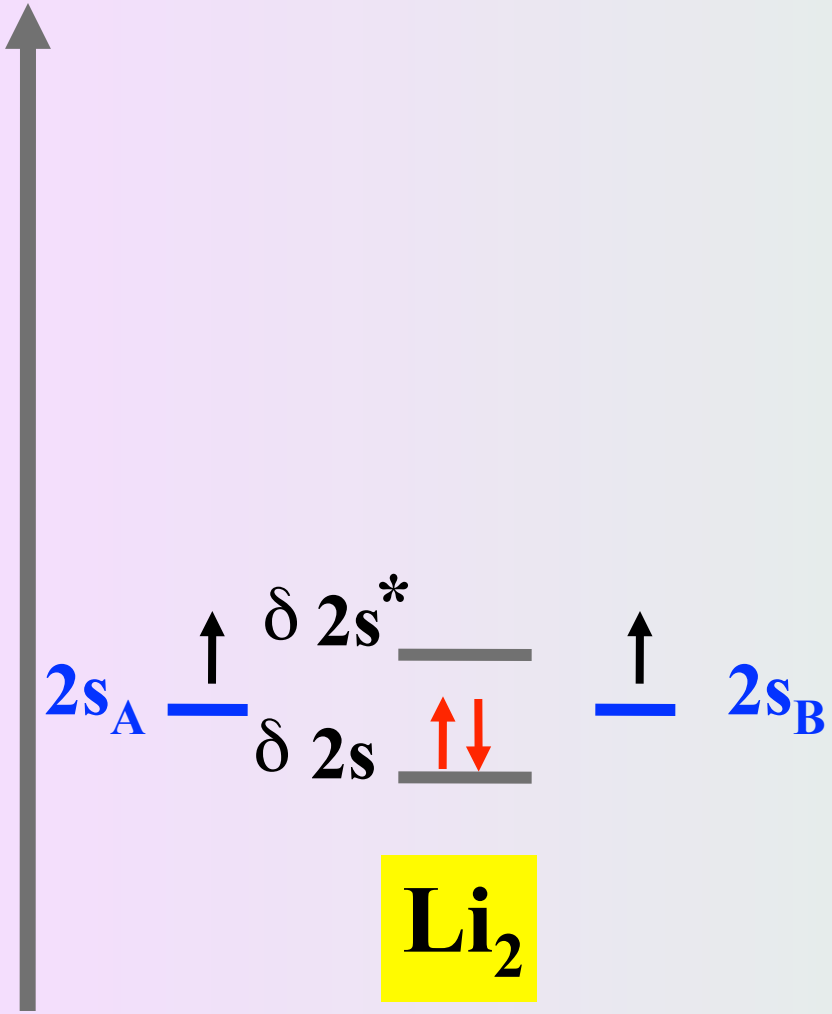


Each circled positive charge represents the nucleus and inner electrons of a metal atom. The blue area indicates a sea of mobile electrons

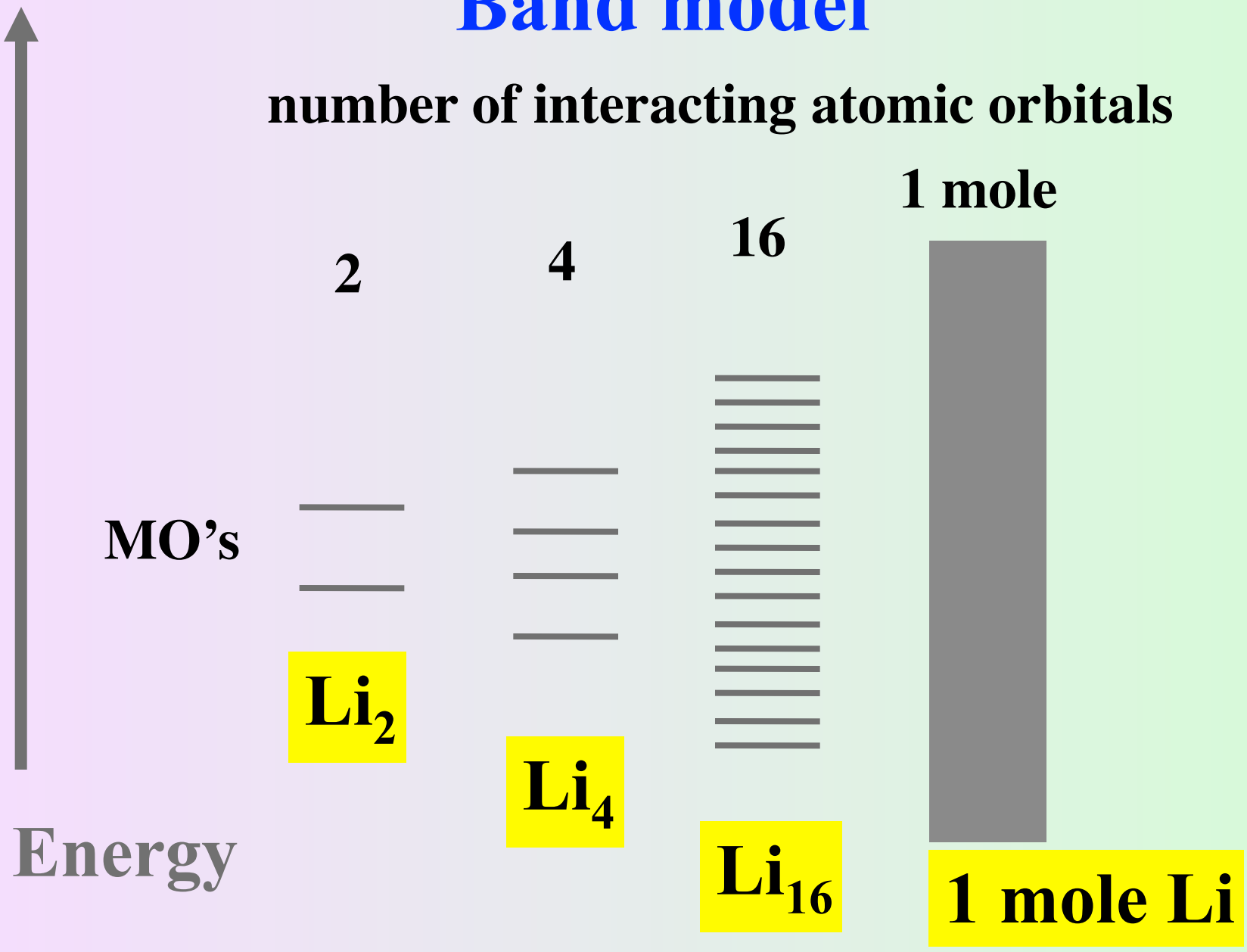

Al3+
e−
positive ions
‘sea of electrons’

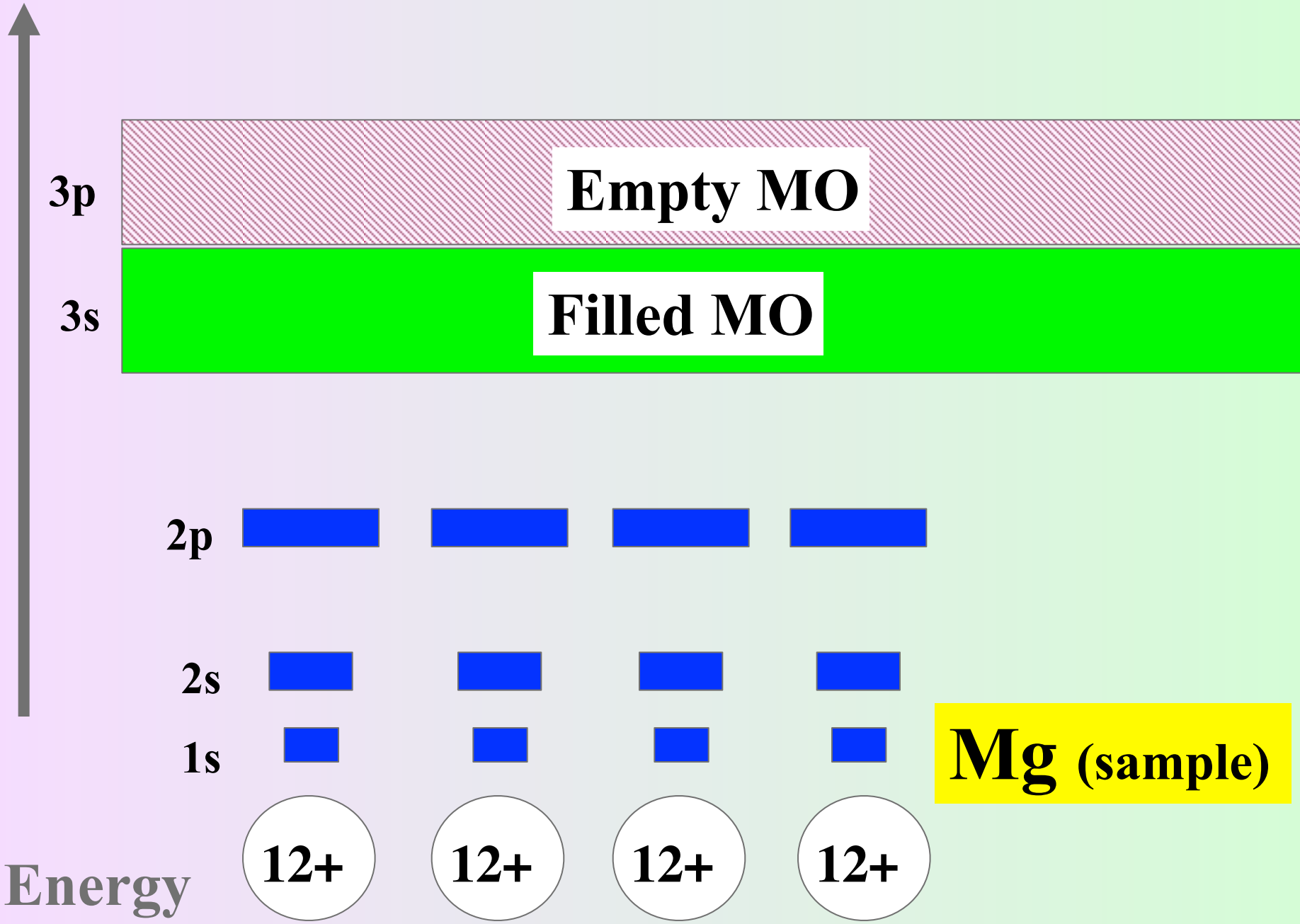
Metallic crystals (Band model)

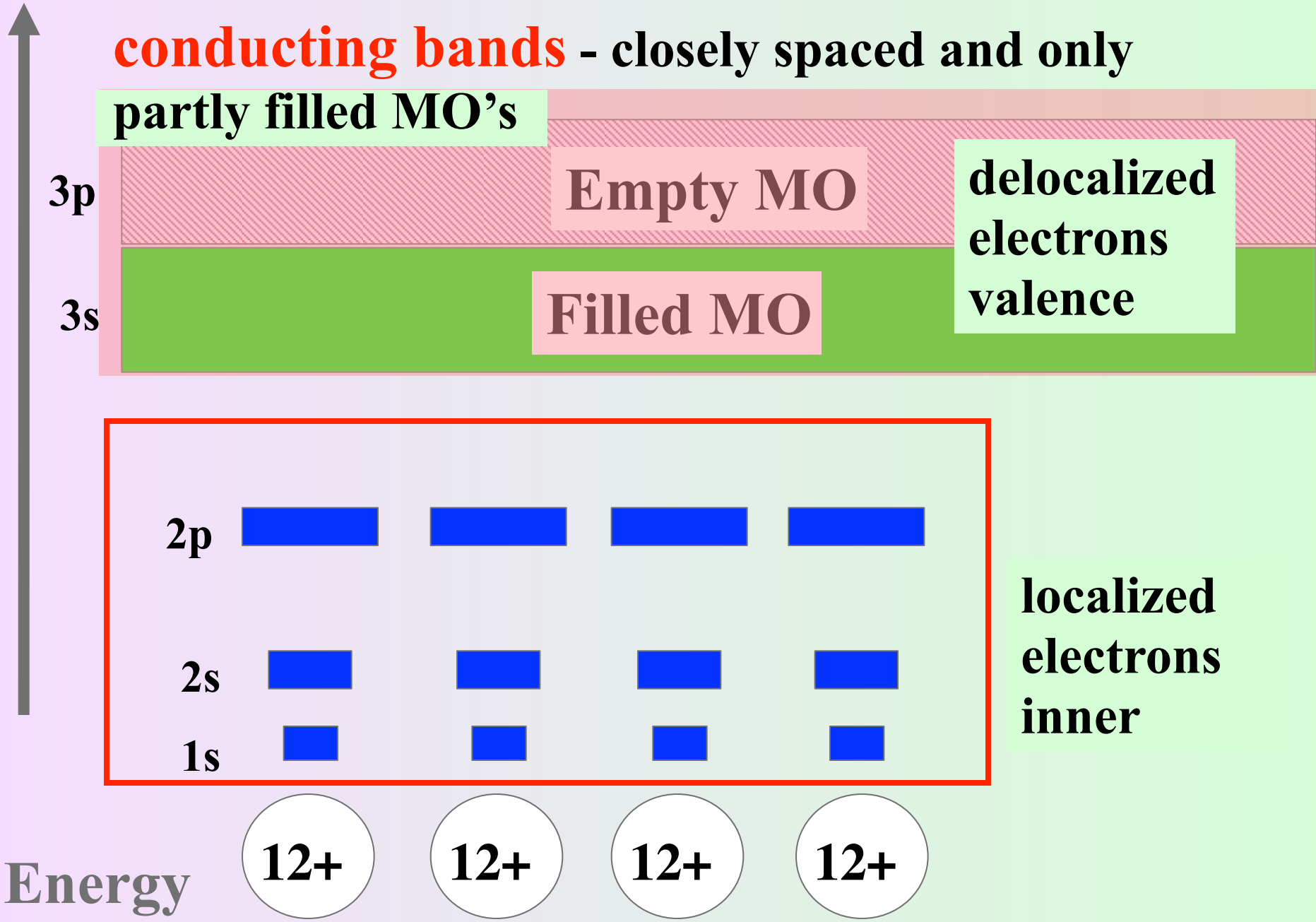
Electrons travel around the metal crystal in molecular orbitals formed from the valence atomic orbitals of the metal atoms


δ 2s*
2s_A
δ 2s
2s_B
Li2
Energy

Band model


number of interacting atomic orbitals
1 mole
2
4
16
MO's
Li2
Li4
Li16
1 mole Li
Energy


3p
Empty MO
3s
Filled MO
2p
2s
1s
12+
12+
12+
12+
Mg (sample)
Energy


conducting bands - closely spaced and only partly filled MO's
3p
3s
Empty MO
Filled MO
delocalized electrons valence
2p
2s
1s
localized electrons inner
12+
12+
12+
12+
Energy

Properties of Metals

Conduct electricity

malleable

ductile

Metal Alloys

Contain a mixture of elements and have metallic properties

Substitution Alloys

Some of the host metal atoms are replaced by other metal atoms of similar size

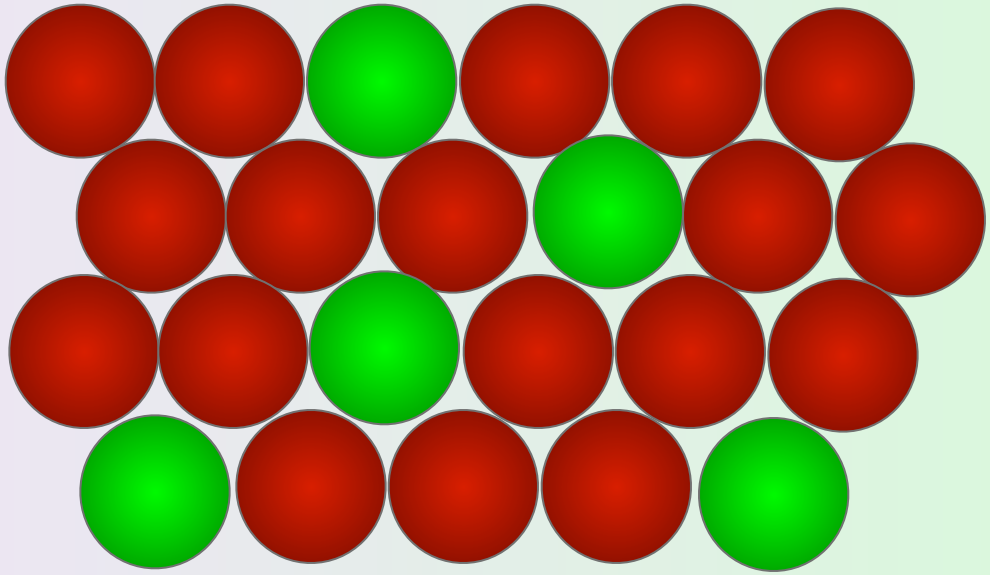
Brass

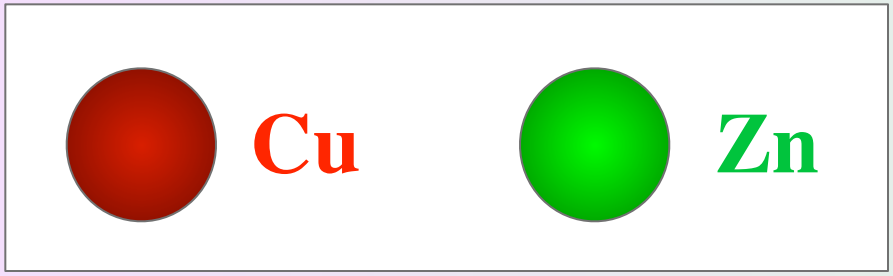
copper and 33.3% zinc

Sterling silver

Silver and 7% copper

Substitution Alloys





interstitial Alloys

Formed when some of the interstices (holes) in the closest packed metal structure are occupied by small atoms

Steel

carbon in the holes of iron

low	**.2%**	**some what malleable**
medium	**.2 - .6%**	**harder**
high	**.6 - 1.5%**	**tool grade**

interstitial Alloys