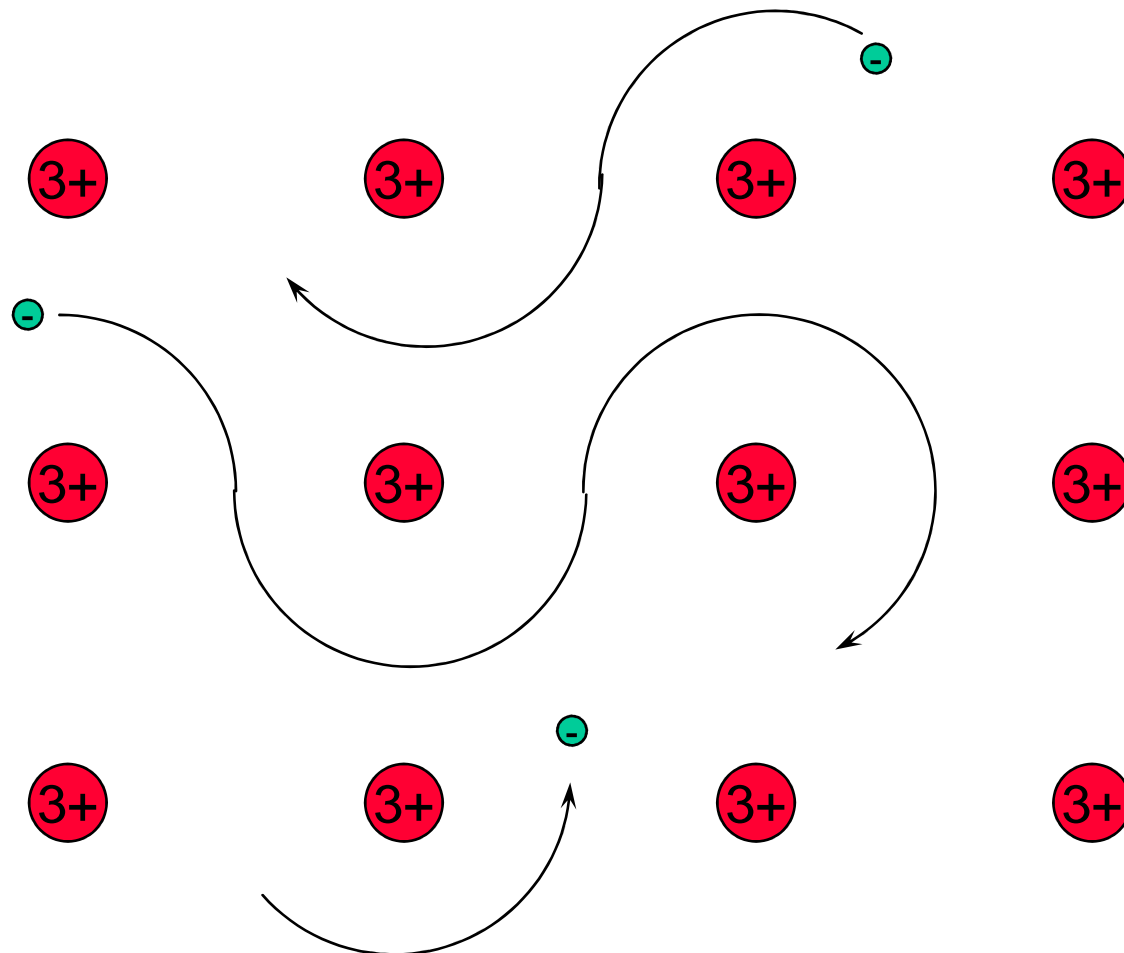


metals in the periodic table

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn

the metallic bond:

electrons move freely in a regular lattice formed by one or more types of metal cations (example: Lithium):



common properties of metals

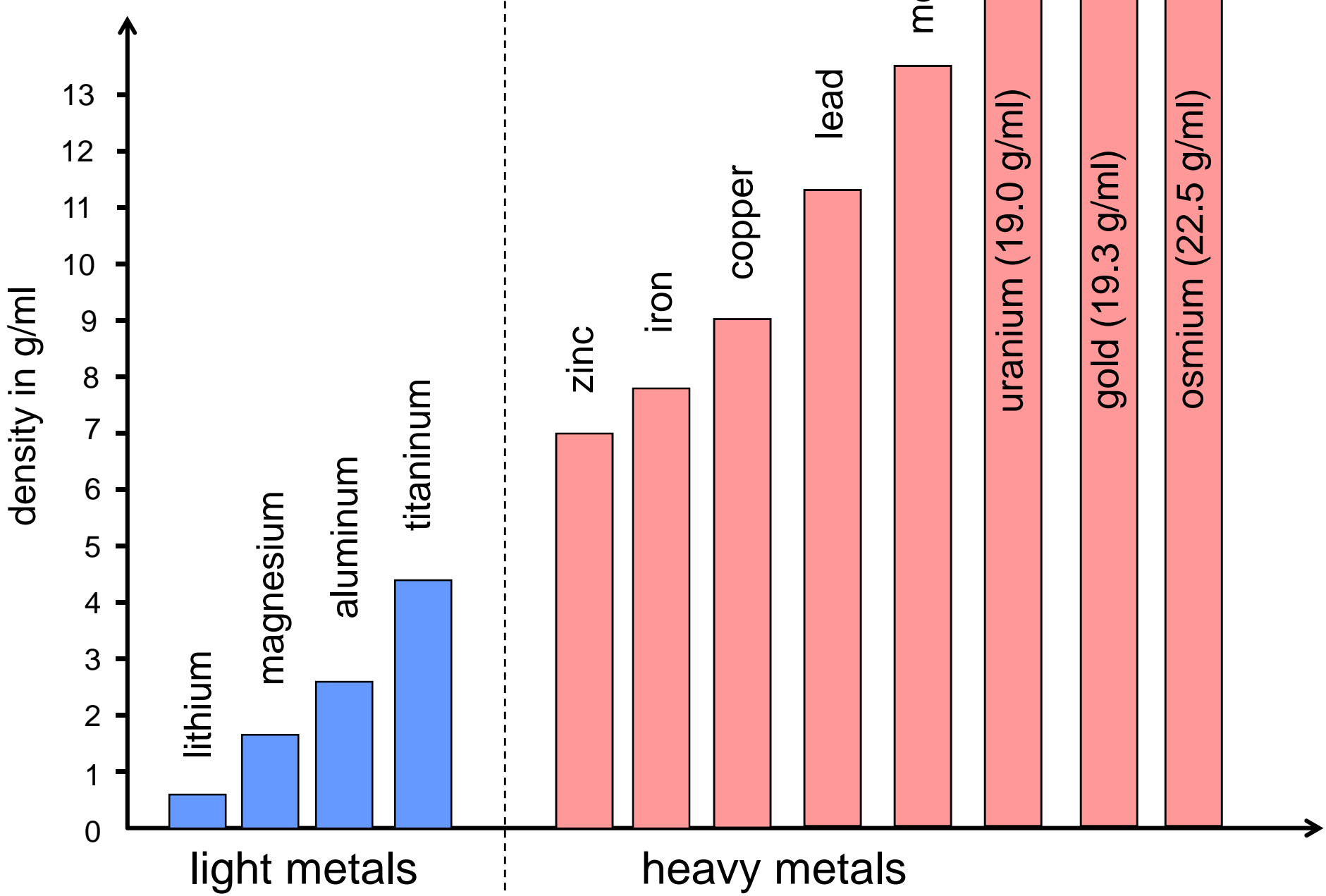
physical
properties:

- shiny „metallic“ appearance,
- high electrical and thermal conductivity,
- high ductility (easily being brought into a given shape by external force);

chemical
properties:

- react with acids to form salts under development of hydrogen
- have the potential to reduce (add electrons to or remove oxygen from) other compounds
- may be oxidized by elements of the sixth or seventh group of the periodic table (e.g. by oxygen, flourine, chlorine, bromine).

properties of metals: density



lattice structure of metals

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn



cubic space-centered lattice

(csc)

68% V_{me}/V



hexagonally close-packed lattice

(hcp)

74% V_{me}/V



cubic close-packed lattice

(ccp)

74% V_{me}/V

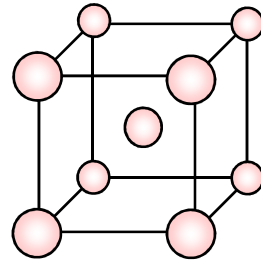


other lattices

 cubic space-centered lattice

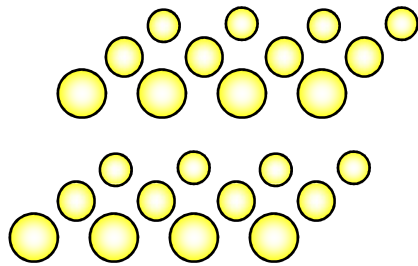
(csc)

68% V_{me}/V



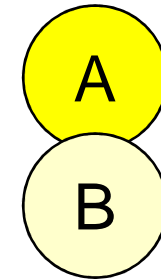
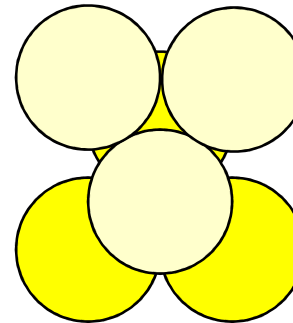
 hexagonally close-packed lattice (hcp)

74% V_{me}/V



B

A



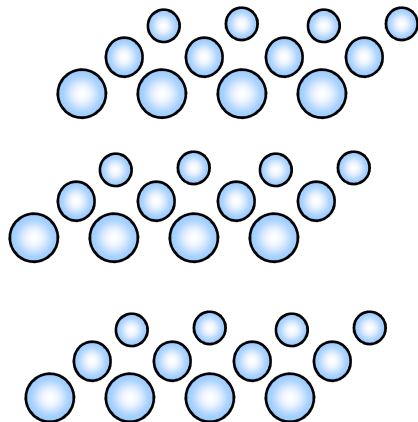
A

B

 cubic close-packed lattice

(ccp)

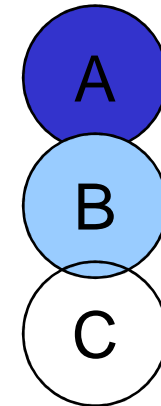
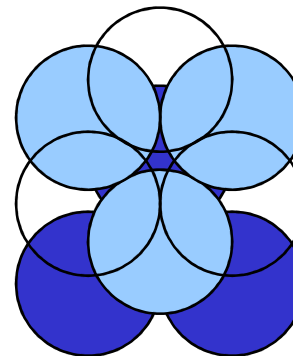
74% V_{me}/V



C

B

A

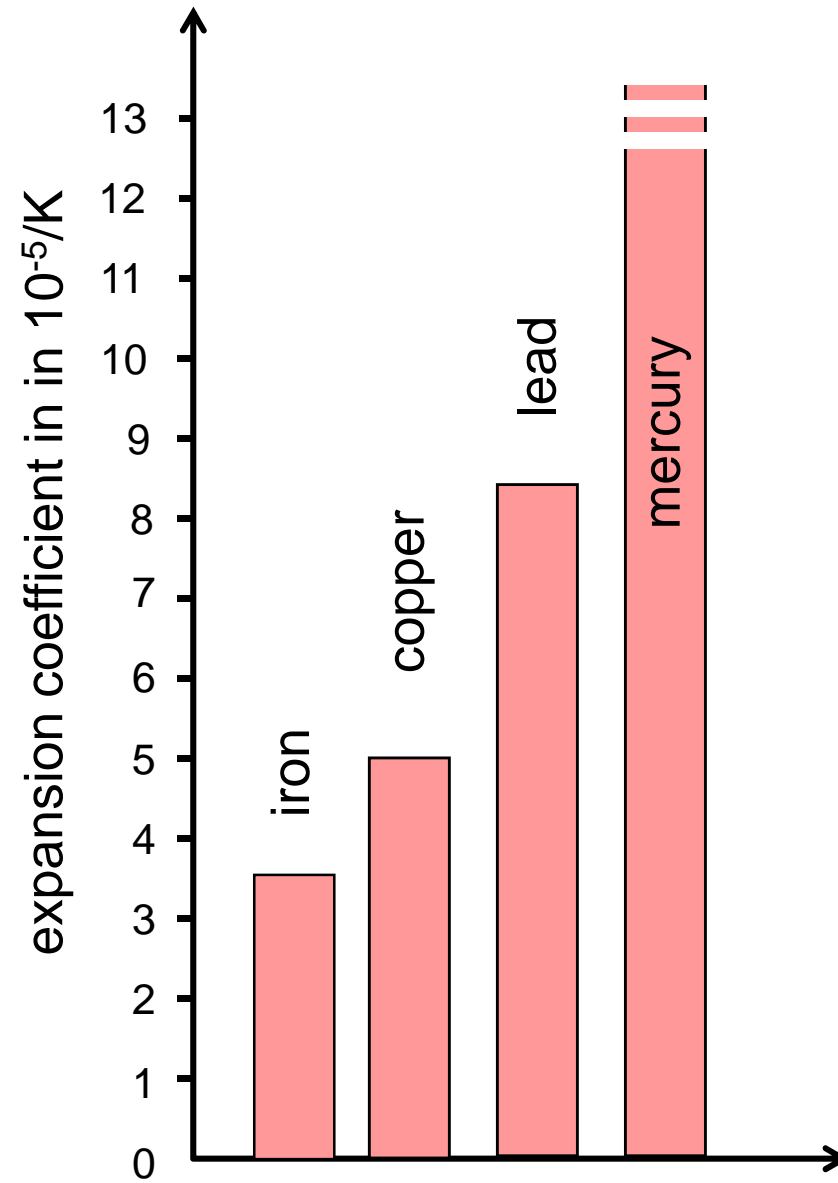


A

B

C

properties of metals: expansion coefficients

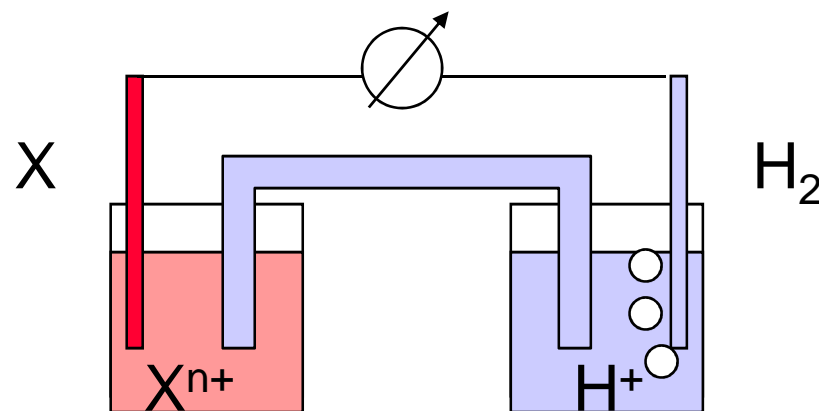


inert, corrosion-resistant metals

H																He	
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn

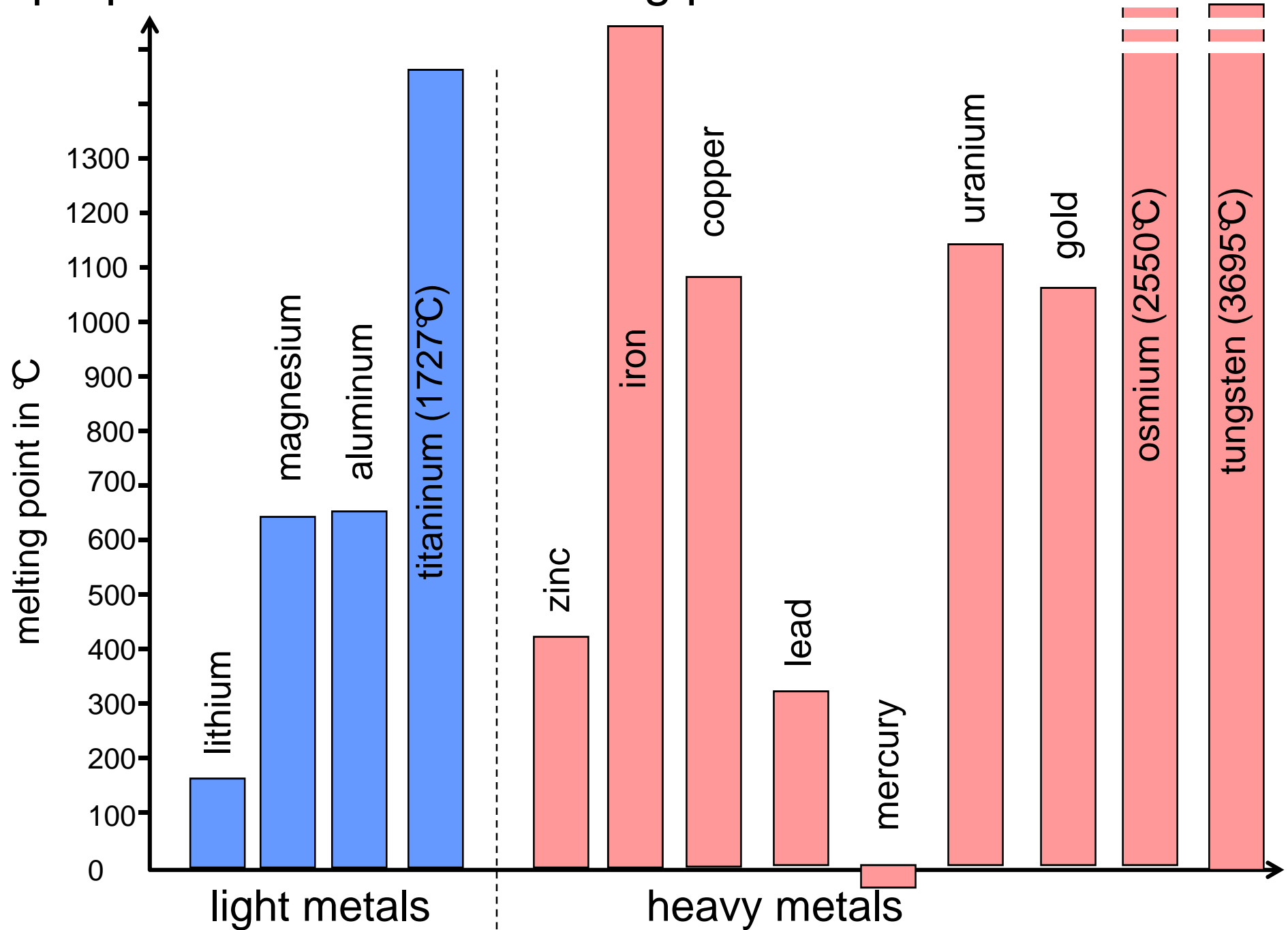
properties of metals: general reactivity

(related to the voltage in the galvanic cell)



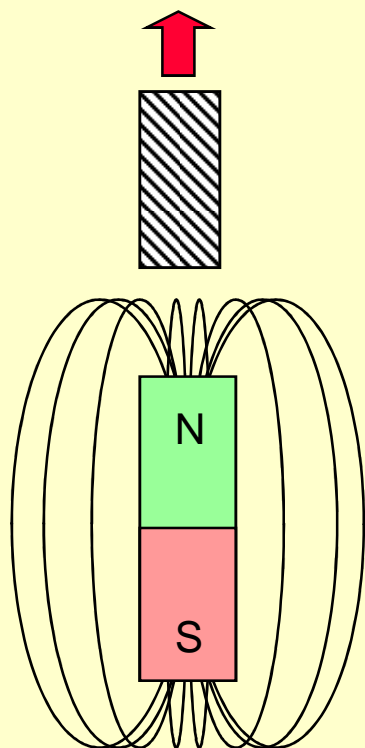
high reactivity			low reactivity		
(all values in V against H ₂)					
Li	lithium	- 2.96	Cd	cadmium	- 0.40
K	potassium	- 2.92	Co	cobalt	- 0.28
Ca	calcium	- 2.76	Ni	nickel	- 0.23
Na	sodium	- 2.71	Sn	tin	- 0.16
Mg	magnesium	- 2.34	Pb	lead	- 0.12
Al	aluminum	- 1.33	H ₂	hydrogen	0
Mn	manganese	- 1.10	Cu	copper	0.34
Zn	zinc	- 0.76	Ag	silver	0.79
Cr	chromium	- 0.51	Hg	mercury	0.85
Fe	iron	- 0.44	Au	gold	1.36
			Pt	platinum	1.60

properties of metals: melting point



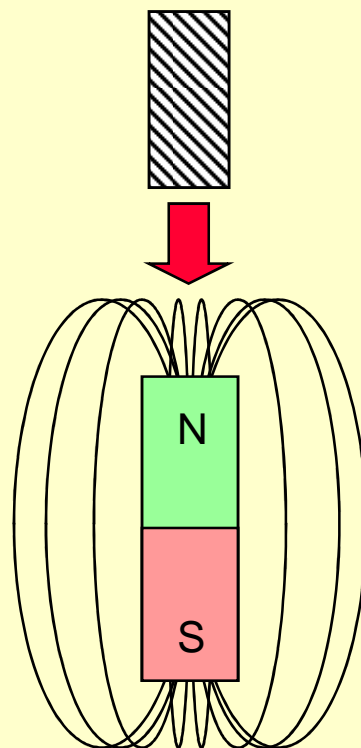
properties of metals: magnetism

diamagnetic
e.g. Cu, Ag, Bi



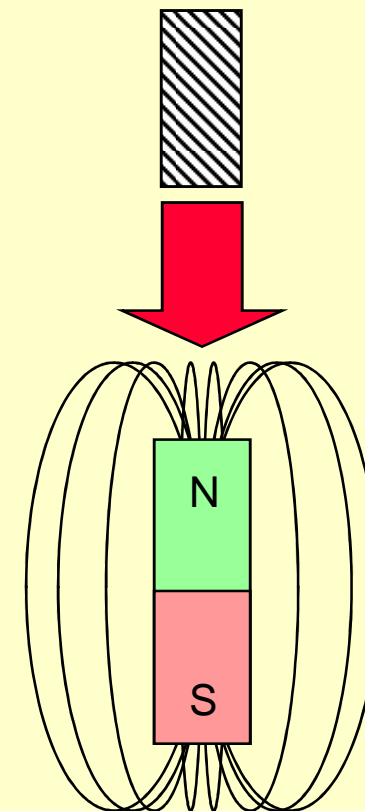
inhomogeneous
magnetic field

paramagnetic
e.g. Pt, Al



inhomogeneous
magnetic field

ferromagnetic
e.g. Fe, Co, Ni



inhomogeneous
magnetic field

natural occurrence of elementary metals

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn



in meteorites

All other metals naturally occur as compounds (mainly oxides and sulfides).