Materials

Engineering materials are divided into main groups:

- metals
- non-metals

1. Metals

As iron is a widely used material, metals are divided into:

- ferrous (>90%)
- non-ferrous

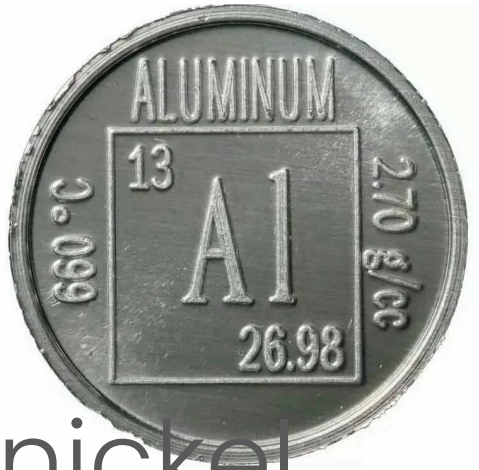
Ferrous metals

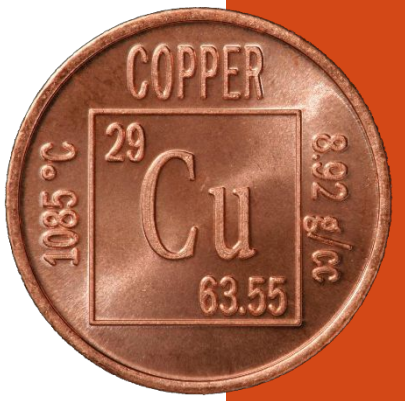
Iron and iron-based alloys:

- steel
- ferroalloy
- cast iron

☝ manganese, chromium

Non-ferrous metals





- aluminium, copper, lead, nickel, tin, titanium, zinc
- alloys: bronze, brass, duralu
- precious metals: gold, silver, platinum
- exotic & rare metals: cobalt, mercury, tungsten, germanium, selenium, vanadium


Steel
Copper alloy
Stainless steel
Grinding chips
Aluminium
Red Brass
Brass
Bronze
Red brass
Copper
Cast Iron
Magnesium
Zinc
Aluminium

2. Non-metals

- organic
  non-metals
  based on carbon
- inorganic
  non-metals do
  not contain
  carbon-hydrogen
  bonds

Organic non-metals

natural organic non-met

- wood
- natural polymers
  - latex, rubber
  - resins

synthetic organic non-metals:

- synthetic polymers (plastics)
  - thermoplastics
  - thermosetting plastics
  - elastomers

Inorganic non-metals

natural inorganic non-m

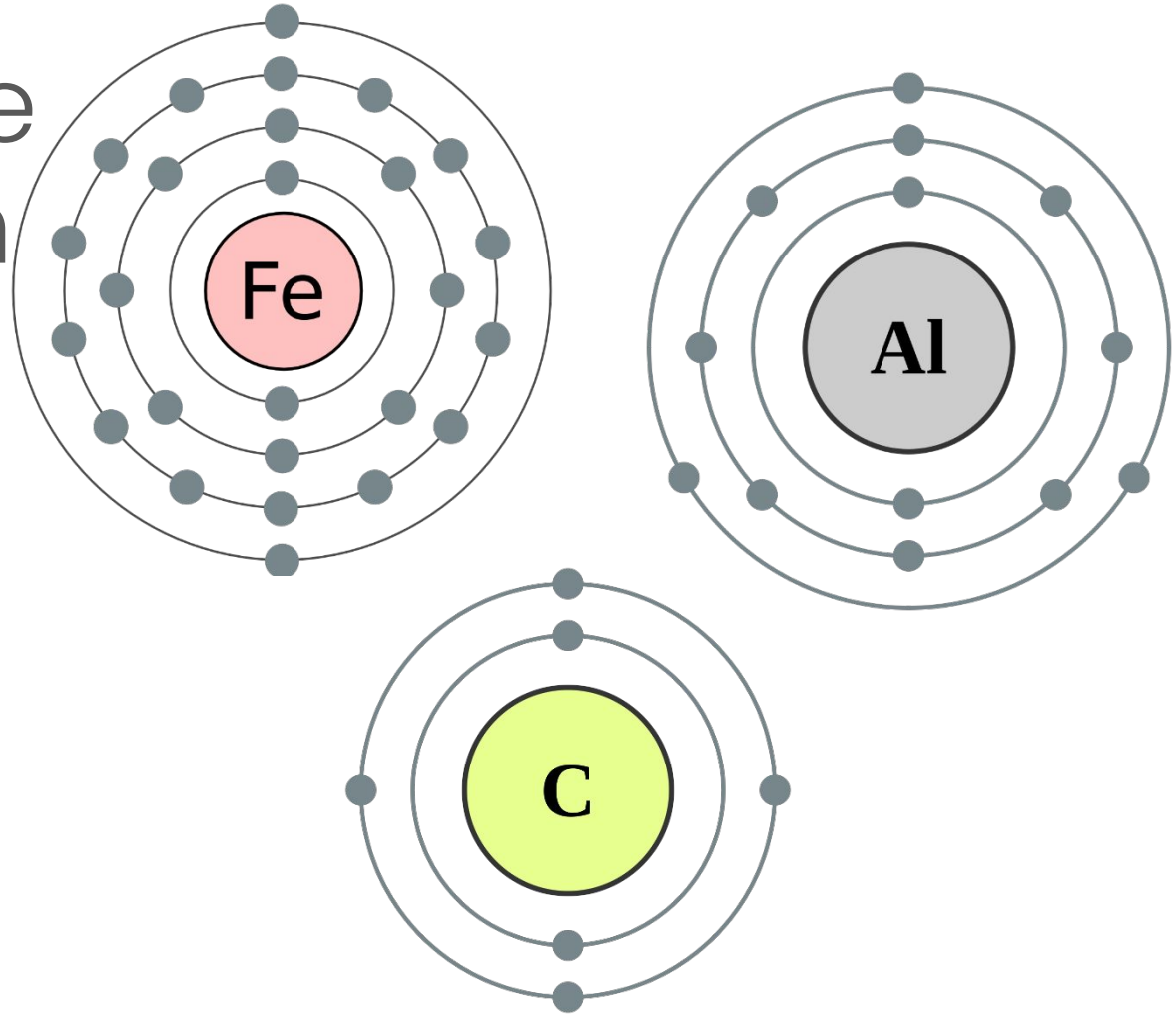
- minerals
- silicon

synthetic inorganic non-metals:

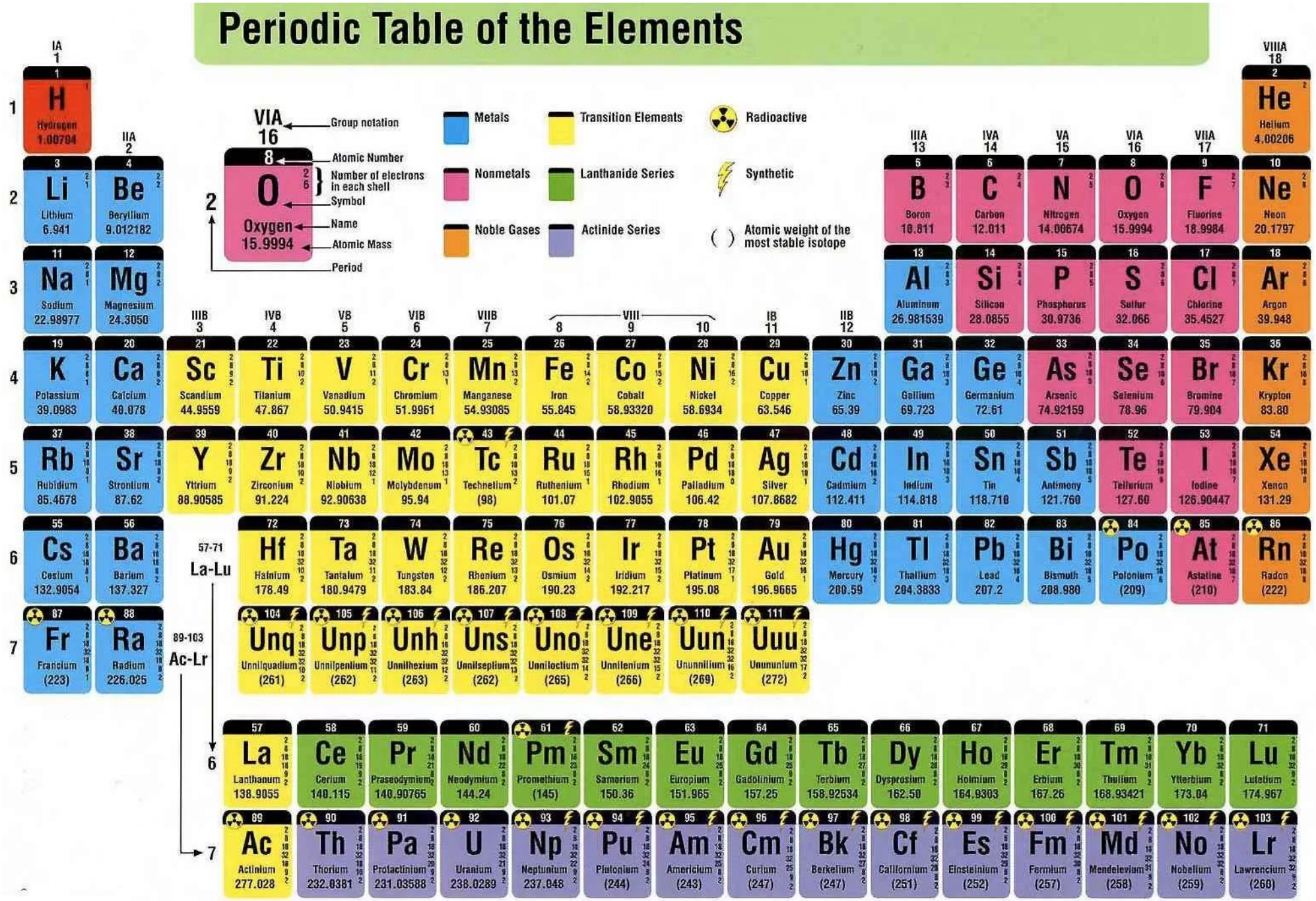
- ceramics
- glass
- cement

3. Chemical composition

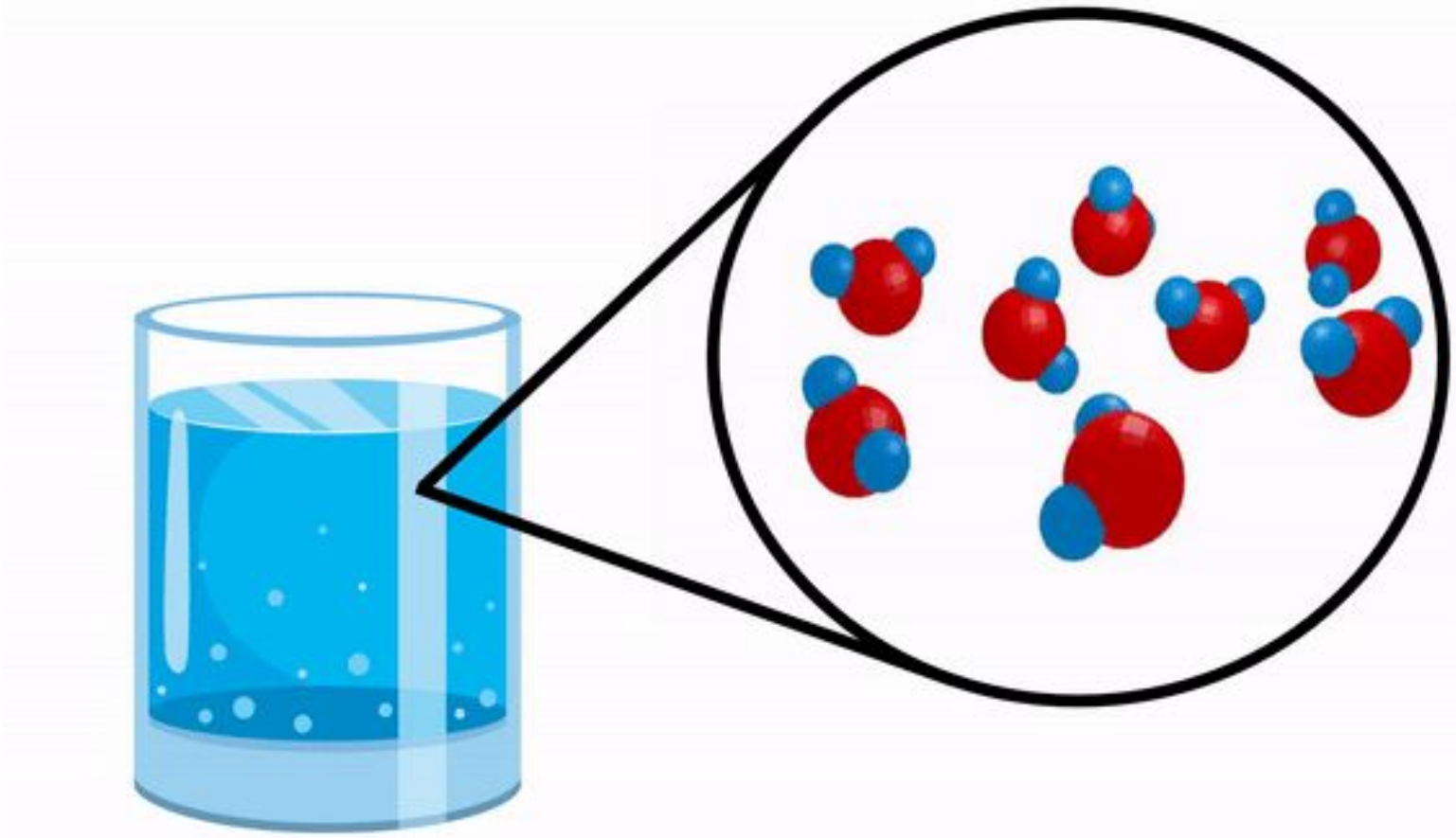
- elements – pure materials which cannot be broken down into different constituents

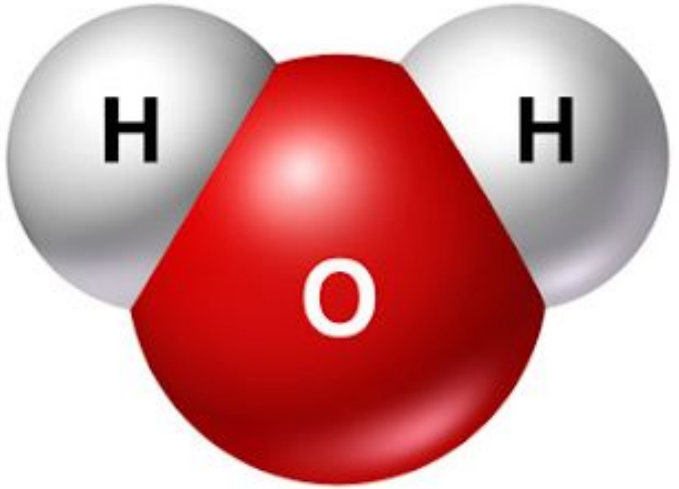


iron, carbon, aluminium


Periodic Table of the Elements
VIA
16
8
O
Oxygen
15.9994
Group notation
Atomic Number
Number of electrons in each shell
Symbol
Name
Atomic Mass
Period
Metals
Nonmetals
Noble Gases
Transition Elements
Lanthanide Series
Actinide Series
Radioactive
Synthetic
( ) Atomic weight of the most stable isotope
IA 1
IIA 2
IIIA 13
IVA 14
VA 15
VIA 16
VIIA 17
VIIIA 18
IIIB 3
IVB 4
VB 5
VIB 6
VIIB 7
VIII 8 9 10
IB 11
IIB 12
57-71 La-Lu
89-103 Ac-Lr
H Hydrogen 1.00794
He Helium 4.00206
Li Lithium 6.941
Be Beryllium 9.012182
B Boron 10.811
C Carbon 12.011
N Nitrogen 14.00674
O Oxygen 15.9994
F Fluorine 18.9984
Ne Neon 20.1797
Na Sodium 22.98977
Mg Magnesium 24.3050
Al Aluminum 26.981539
Si Silicon 28.0855
P Phosphorus 30.9736
S Sulfur 32.066
Cl Chlorine 35.4527
Ar Argon 39.948
K Potassium 39.0983
Ca Calcium 40.078
Sc Scandium 44.9559
Ti Titanium 47.867
V Vanadium 50.9415
Cr Chromium 51.9961
Mn Manganese 54.93085
Fe Iron 55.845
Co Cobalt 58.93320
Ni Nickel 58.6934
Cu Copper 63.546
Zn Zinc 65.39
Ga Gallium 69.723
Ge Germanium 72.61
As Arsenic 74.92159
Se Selenium 78.96
Br Bromine 79.904
Kr Krypton 83.80
Rb Rubidium 85.4678
Sr Strontium 87.62
Y Yttrium 88.90585
Zr Zirconium 91.224
Nb Niobium 92.90638
Mo Molybdenum 95.94
Tc Technetium (98)
Ru Ruthenium 101.07
Rh Rhodium 102.9055
Pd Palladium 106.42
Ag Silver 107.8682
Cd Cadmium 112.411
In Indium 114.818
Sn Tin 118.710
Sb Antimony 121.760
Te Tellurium 127.60
I Iodine 126.90447
Xe Xenon 131.29
Cs Cesium 132.9054
Ba Barium 137.327
Hf Hafnium 178.49
Ta Tantalum 180.9479
W Tungsten 183.84
Re Rhenium 186.207
Os Osmium 190.23
Ir Iridium 192.217
Pt Platinum 195.08
Au Gold 196.9665
Hg Mercury 200.59
Tl Thallium 204.3833
Pb Lead 207.2
Bi Bismuth 208.980
Po Polonium (209)
At Astatine (210)
Rn Radon (222)
Fr Francium (223)
Ra Radium 226.025
Unq Unnilquadium (261)
Unp Unnilpentium (262)
Unh Unnilhexium (263)
Uns Unnilseptium (262)
Uno Unniloctium (265)
Une Unnilenium (266)
Uun Ununnilium (269)
Uuu Unununium (272)
La Lanthanum 138.9055
Ce Cerium 140.115
Pr Praseodymium 140.90765
Nd Neodymium 144.24
Pm Promethium (145)
Sm Samarium 150.36
Eu Europium 151.965
Gd Gadolinium 157.25
Tb Terbium 158.92534
Dy Dysprosium 162.50
Ho Holmium 164.9303
Er Erbium 167.26
Tm Thulium 168.93421
Yb Ytterbium 173.04
Lu Lutetium 174.967
Ac Actinium 277.028
Th Thorium 232.0381
Pa Protactinium 231.03588
U Uranium 238.0289
Np Neptunium 237.048
Pu Plutonium (244)
Am Americium (243)
Cm Curium (247)
Bk Berkelium (247)
Cf Californium (251)
Es Einsteinium (252)
Fm Fermium (257)
Md Mendelevium (258)
No Nobelium (259)
Lr Lawrencium (260)

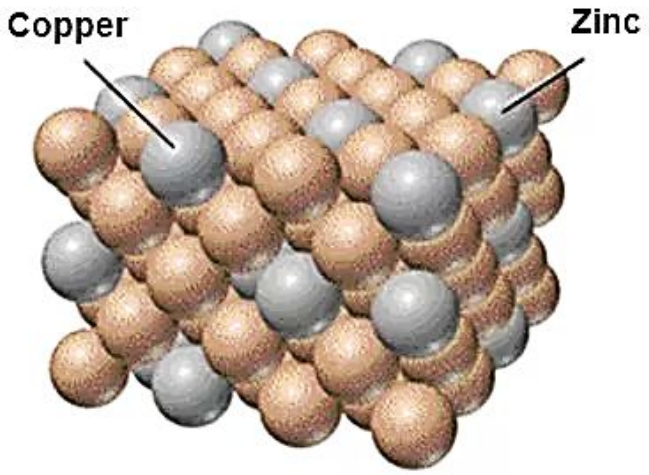
- compounds consist of two or more elements that are combined by a chemical reaction



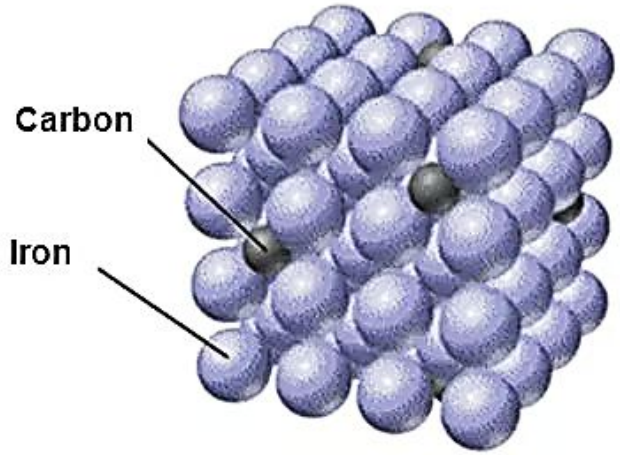


- mixtures consist of two or more elements or compounds which are mixed togeth[illegible] bound

alloys



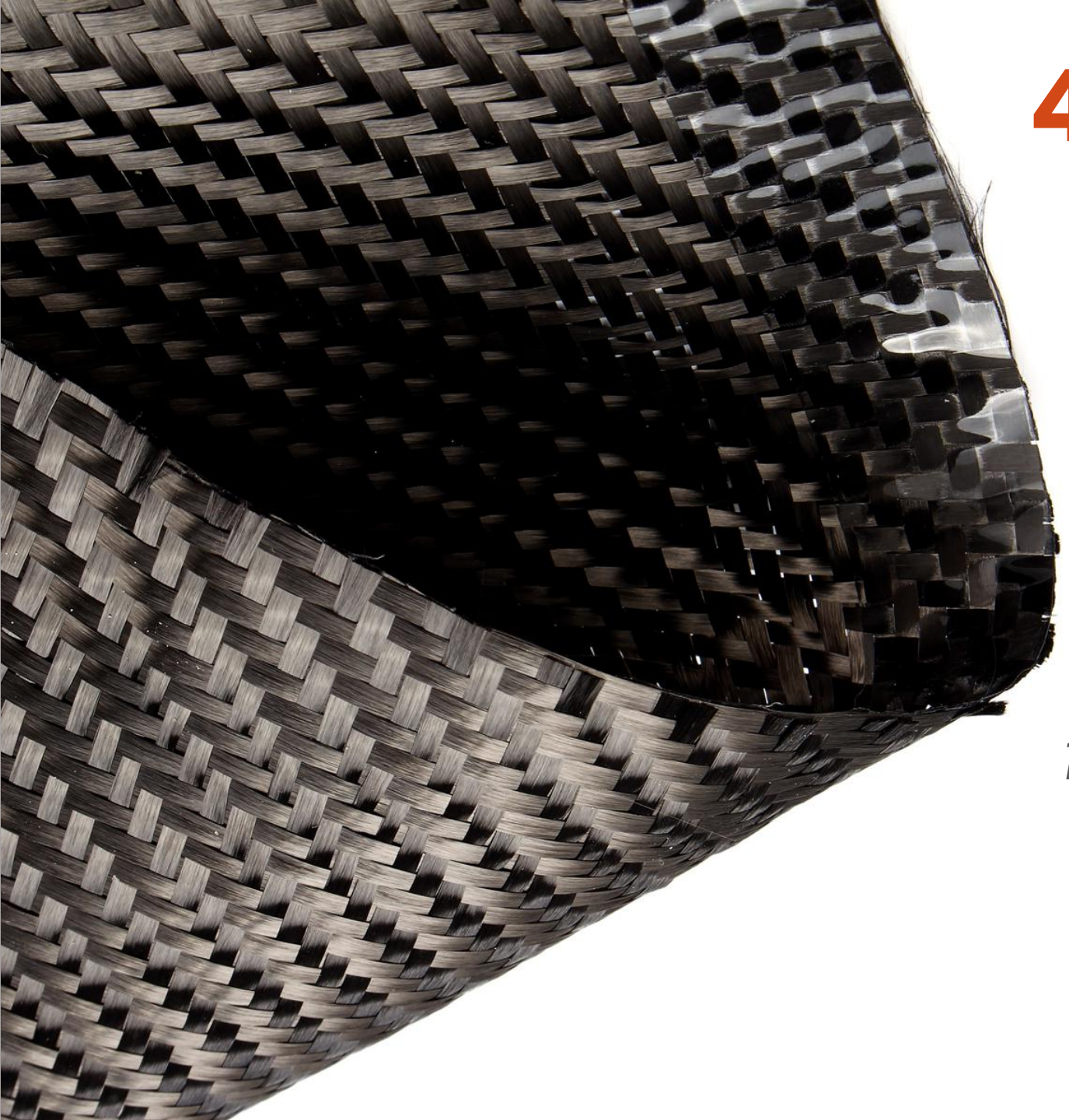
Brass



Carbon steel

alloying metals are added in small quantities to alloys to improve properties of a material

chromium, manganese, tungsten



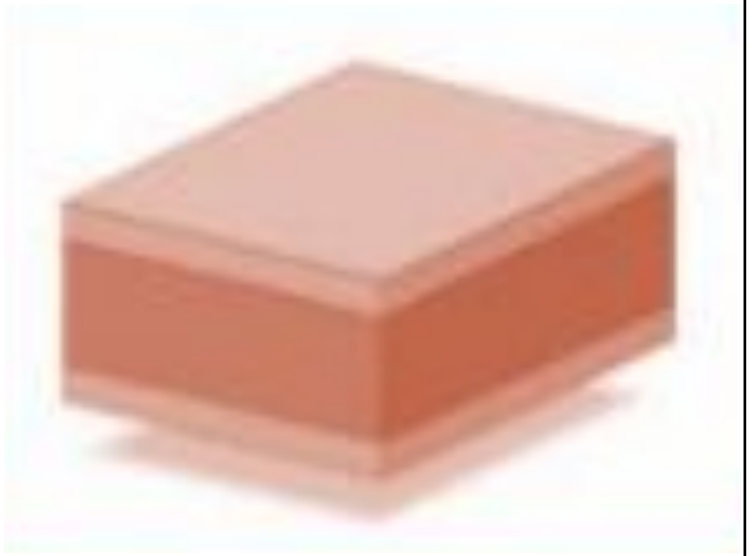
4. Composite materials

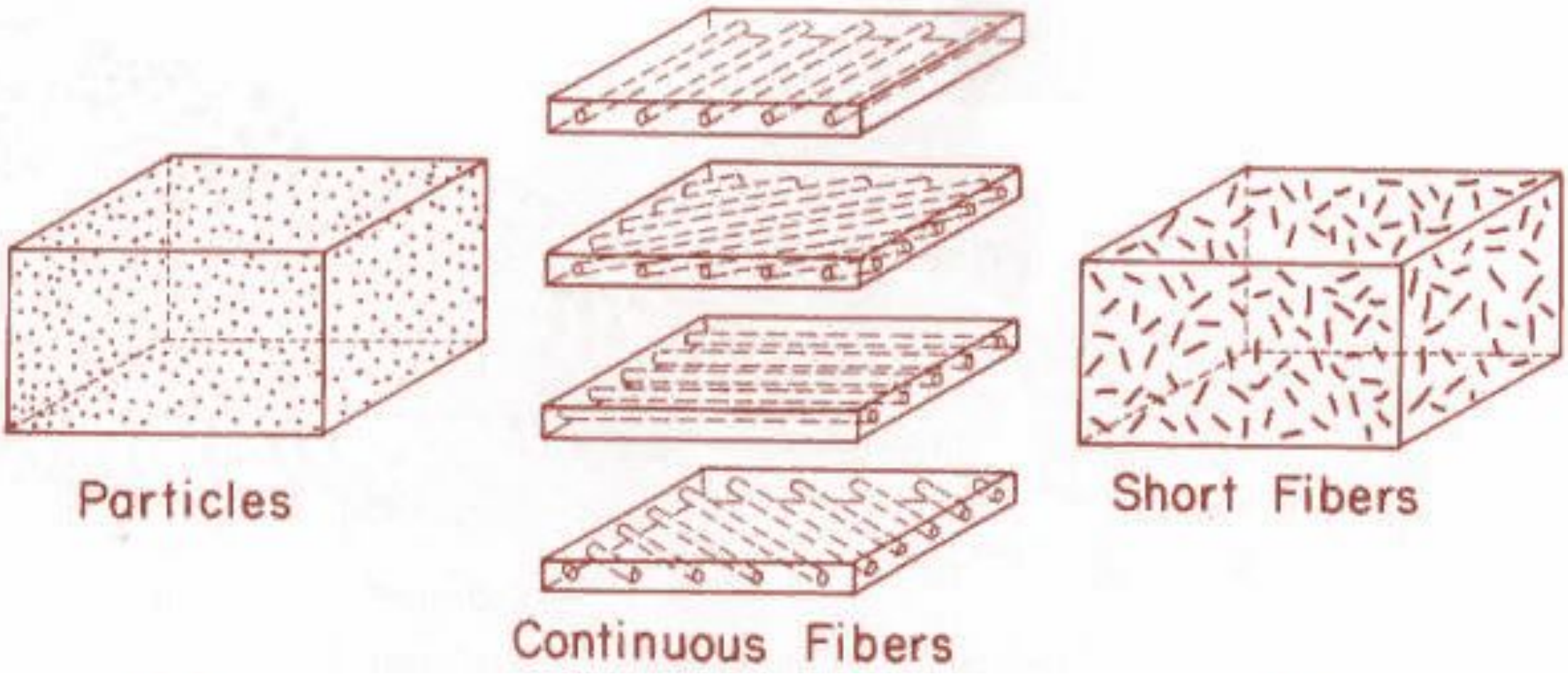
- reinforcement is the structural network that reinforces the material inside

  steel rods, carbon fibre

- matrix

  concrete, plastic

Laminar composite слоистый	Fiber-reinforced composite волокнистый	Particulate composite дисперсноупрочненный
		
two or more layers of different materials bonded together	chopped or continuous fibers	embedded particles


Particles
Continuous Fibers
Short Fibers

https://onlinetestpad.com/ho4rc7agvfdrw