

Metals

Periodic Table of the Elements

Hydrogen 1																	Helium 2						
Lithium 3	Beryllium 4																	Boron 5	Carbon 6	Nitrogen 7	Oxygen 8	Fluorine 9	Neon 10
Sodium 11	Magnesium 12																	Aluminium 13	Silicon 14	Phosphorus 15	Sulfur 16	Chlorine 17	Argon 18
Potassium 19	Calcium 20	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36						
Rubidium 37	Strontium 38	Yttrium 39	Zirconium 40	Niobium 41	Molybdenum 42	Technetium 43	Ruthenium 44	Rhodium 45	Palladium 46	Silver 47	Cadmium 48	Indium 49	Tin 50	Antimony 51	Tellurium 52	Iodine 53	Xenon 54						
Caesium 55	Barium 56	Lanthanides (Below)	Hafnium 72	Tantalum 73	Tungsten 74	Rhenium 75	Osmium 76	Iridium 77	Platinum 78	Gold 79	Mercury 80	Thallium 81	Lead 82	Bismuth 83	Polonium 84	Astatine 85	Radon 86						
Francium 87	Radium 88	Actinides (Below)	Rutherfordium 104	Dubnium 105	Seaborgium 106	Bohrium 107	Hassium 108	Meitnerium 109	Darmstadtium 110	Roentgenium 111	Copernicium 112	Nihonium 113	Flerovium 114	Moscovium 115	Livermorium 116	Tennessine 117	Oganesson 118						



Nonmetals



Metals



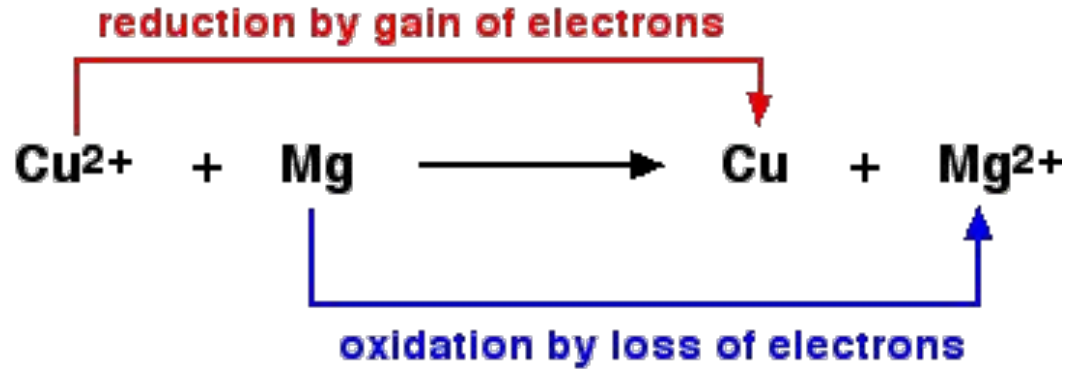
Semimetals



ChemTalk
www.chemistrytalk.org

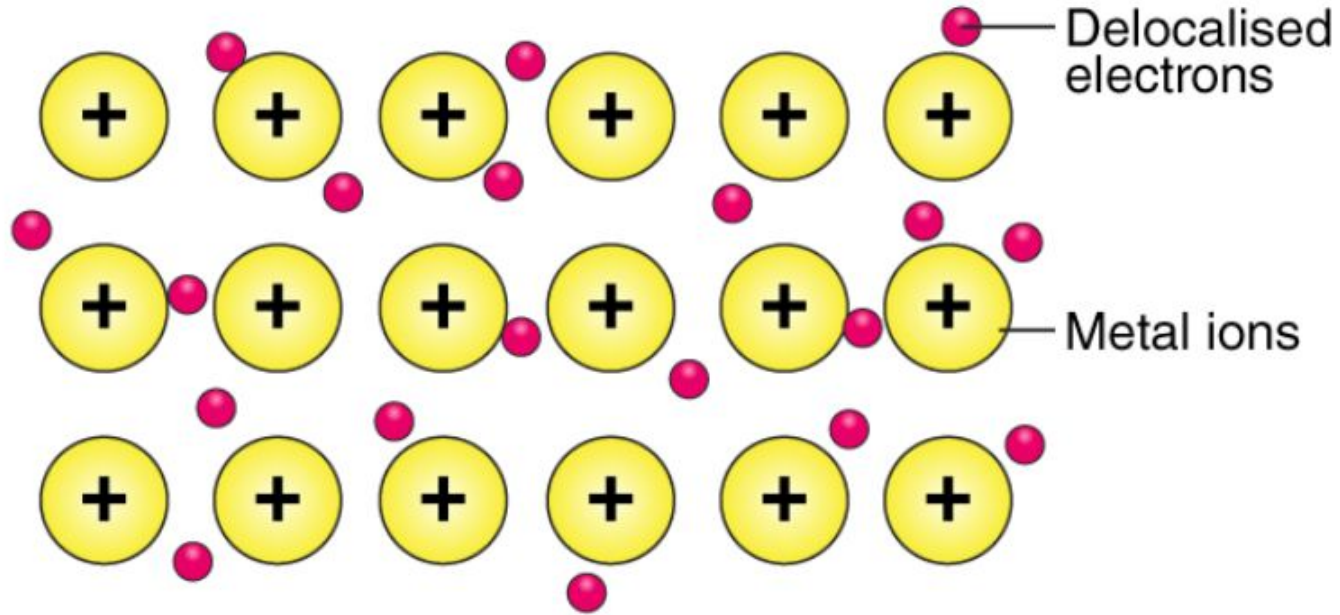
Lanthanum 57	Cerium 58	Praseodymium 59	Neodymium 60	Promethium 61	Samarium 62	Europium 63	Gadolinium 64	Terbium 65	Dysprosium 66	Holmium 67	Erbium 68	Thulium 69	Ytterbium 70	Lutetium 71
Actinium 89	Thorium 90	Protactinium 91	Uranium 92	Neptunium 93	Plutonium 94	Americium 95	Curium 96	Berkelium 97	Californium 98	Einsteinium 99	Fermium 100	Mendelevium 101	Nobelium 102	Lawrencium 103

Reduction and oxidation (redox)

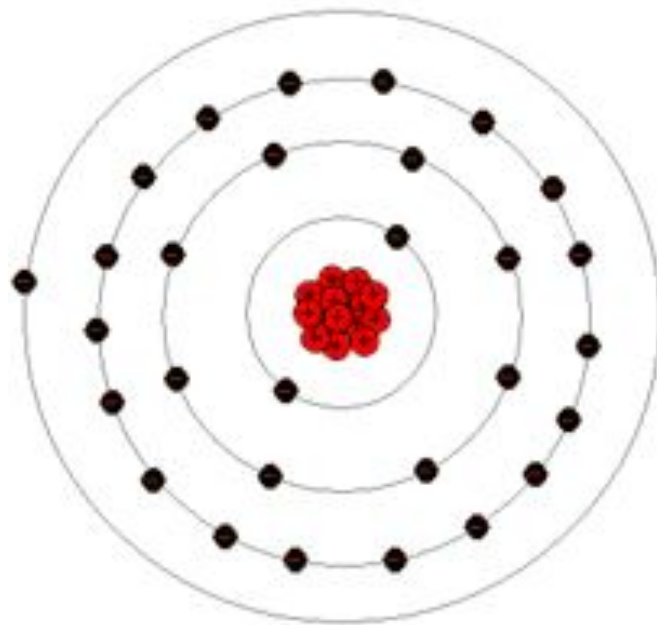


Mnemonic: OIL RIG
Oxidation Is Losing
Reduction Is Gaining

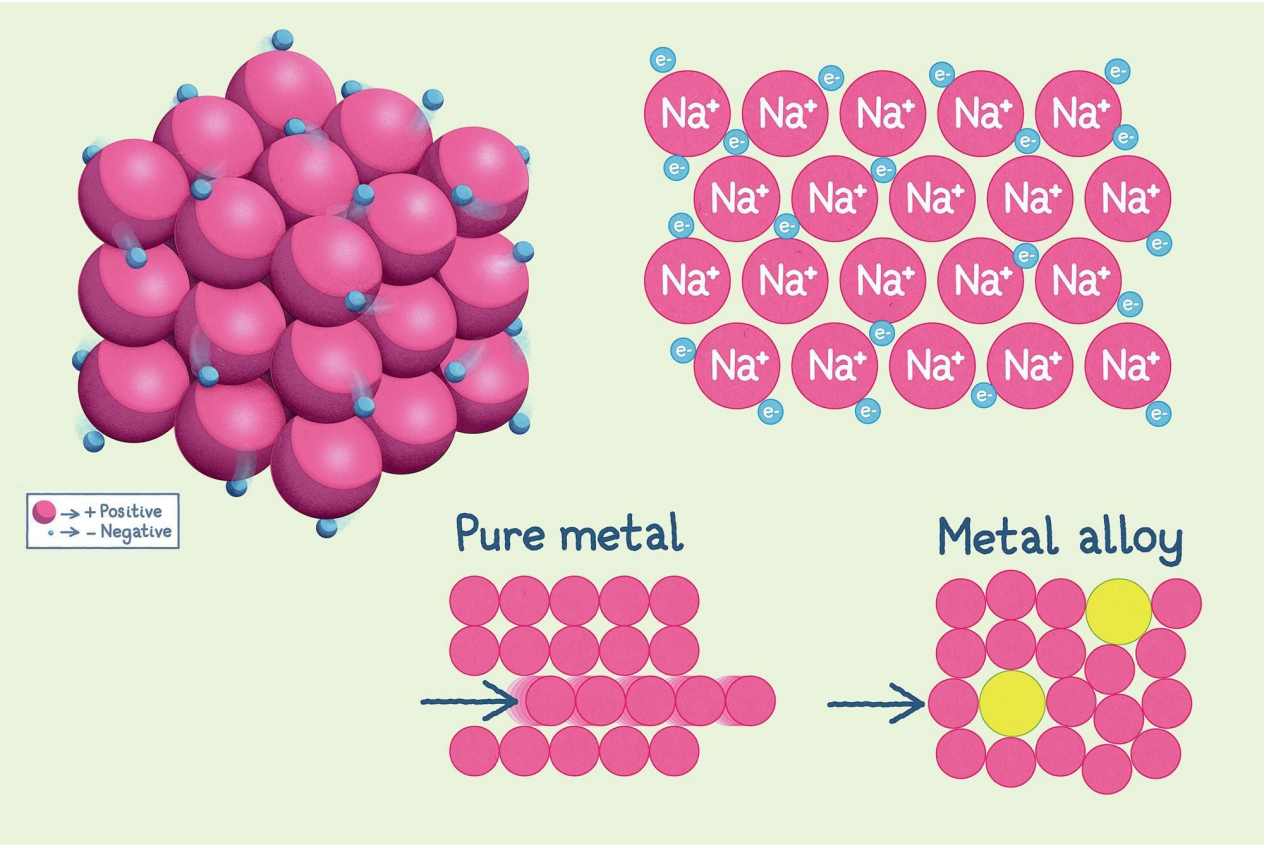
Metallic bonding



Exception: Mercury (Hg)



Alloy



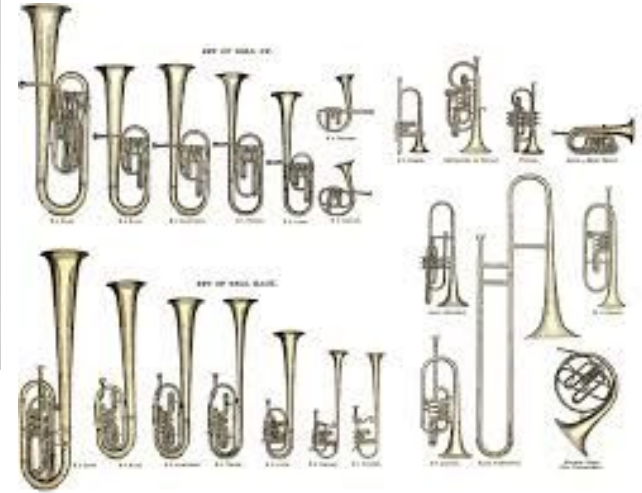
Common alloys



Steel (carbon-iron)



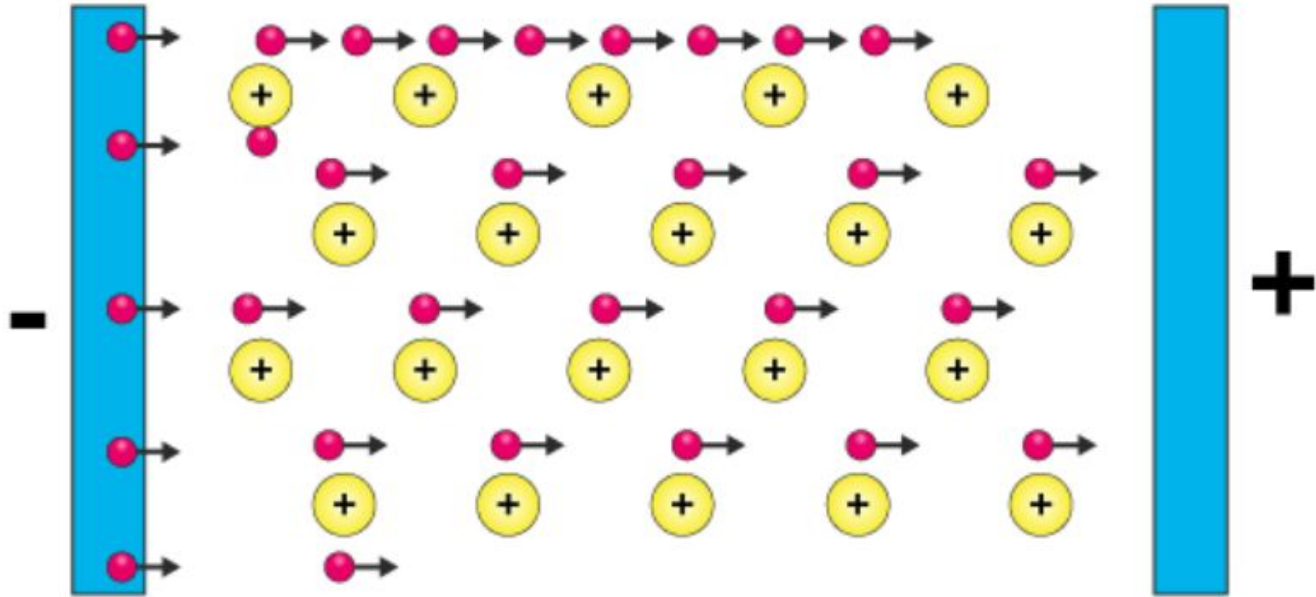
Bronze (copper and tin)



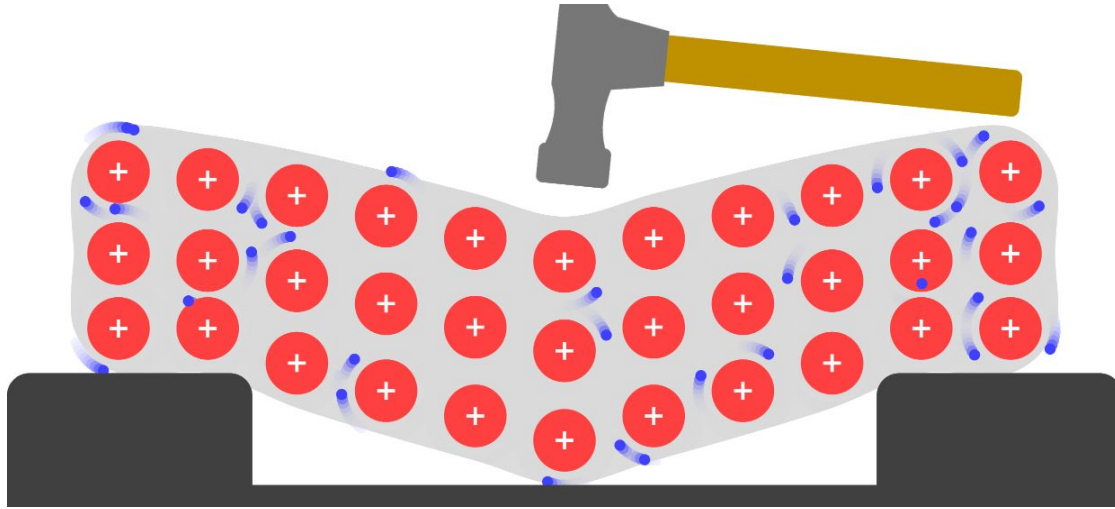
Brass (copper and zinc)

Allow for robust materials
with tunable properties

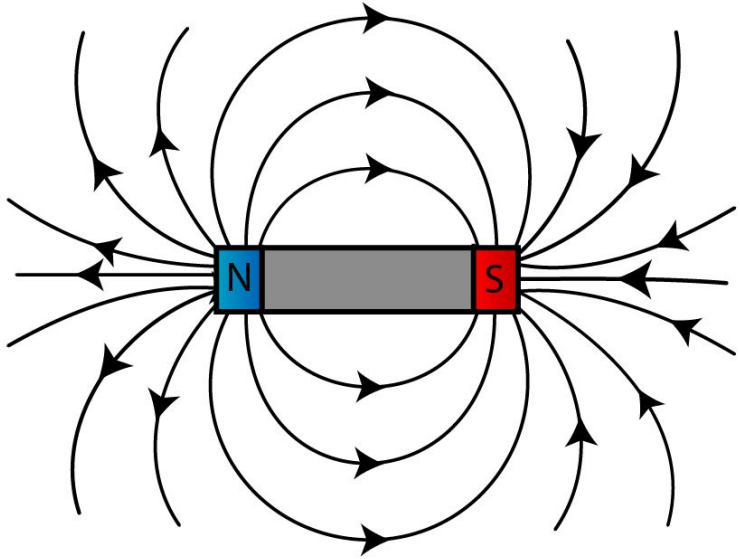
Electronic properties



Malleability and Ductility



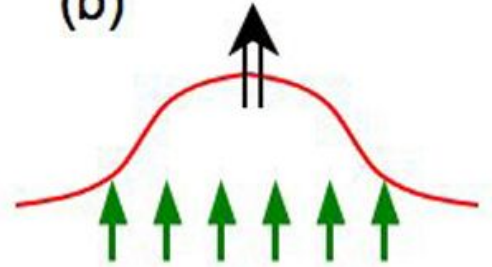
Magnetism



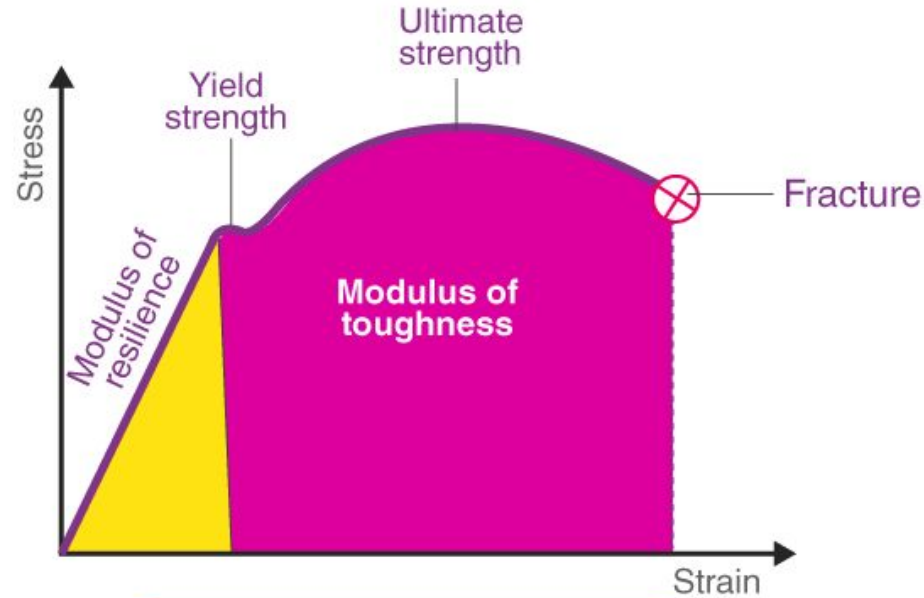
(a)



(b)



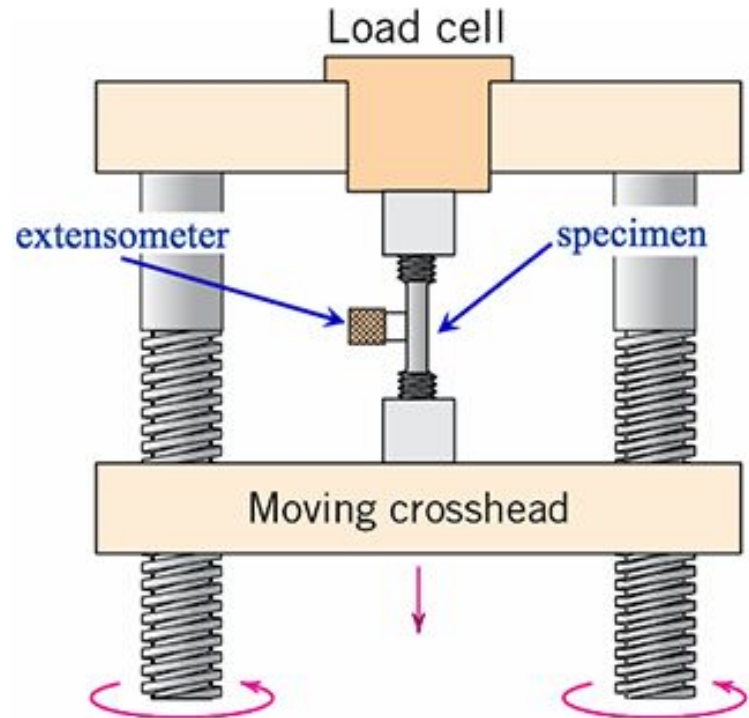
Young's Modulus



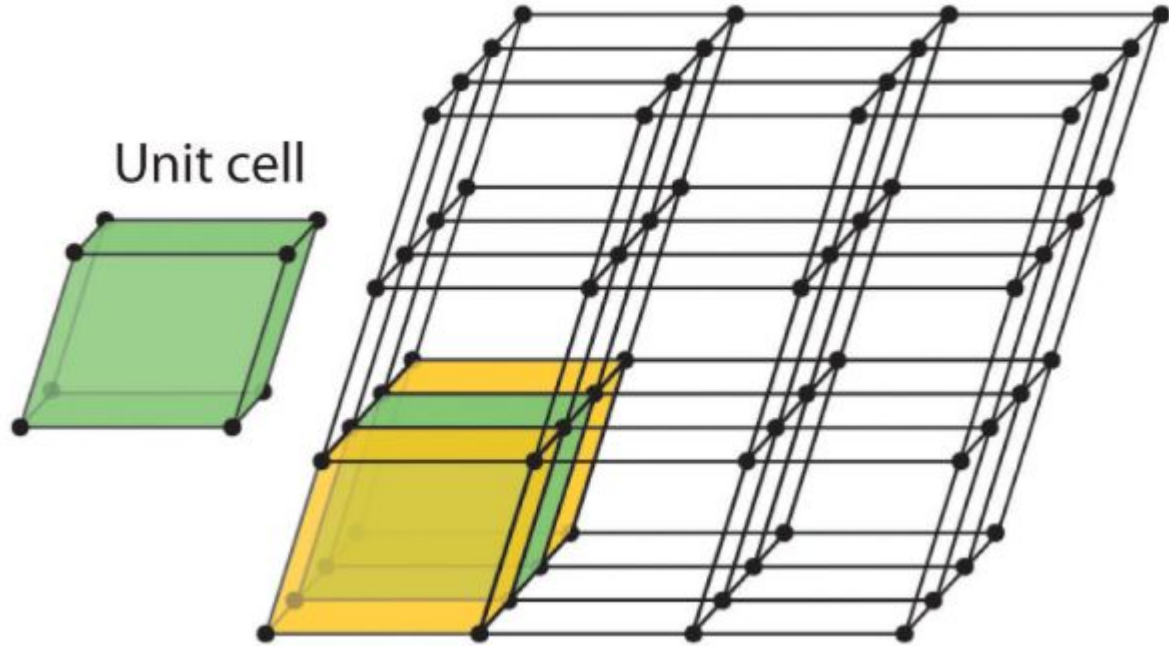
$$\text{Young's Modulus} = \frac{\text{Stress}}{\text{Strain}}$$

Measuring stress vs strain

Typical tensile test machine



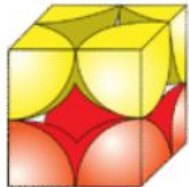
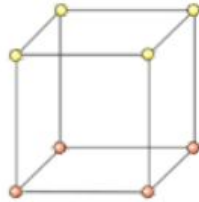
Crystalline solids



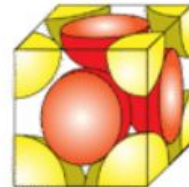
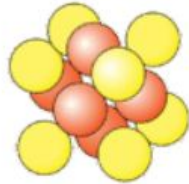
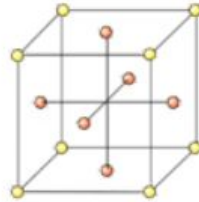
Unit cell: smallest repeating unit in a lattice

Types of repeats

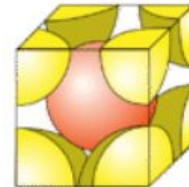
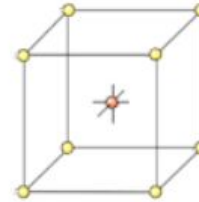
Simple Cubic



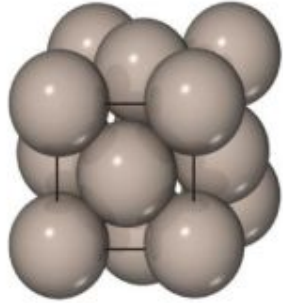
Face-centered cubic



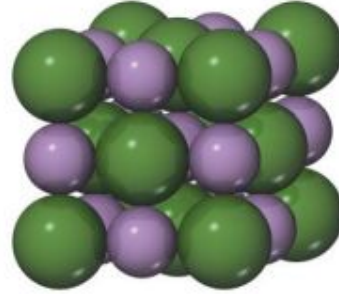
Body-centered cubic



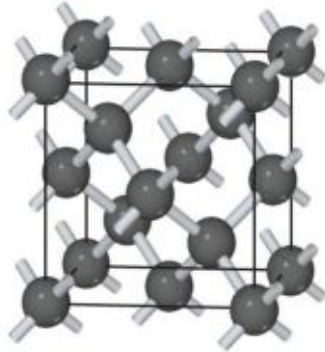
Types of crystal networks



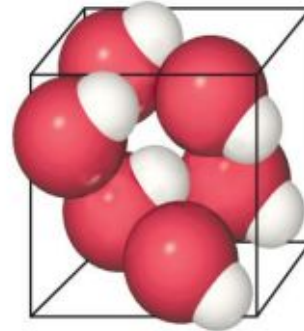
Metallic solids



Ionic solids

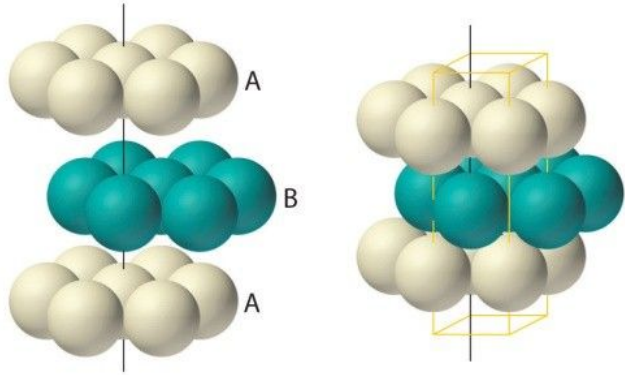


Covalent-network solids

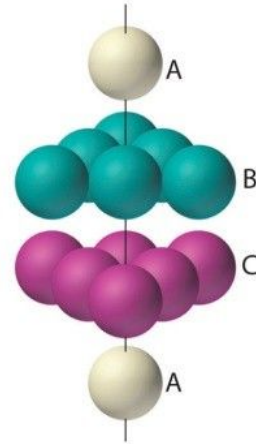
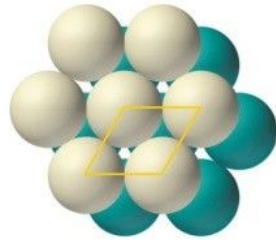


Molecular solids

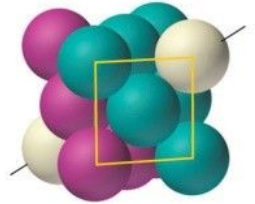
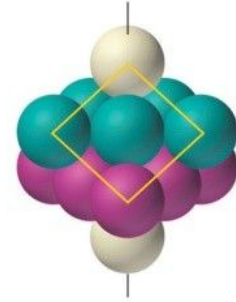
Packing efficiency of unit cells



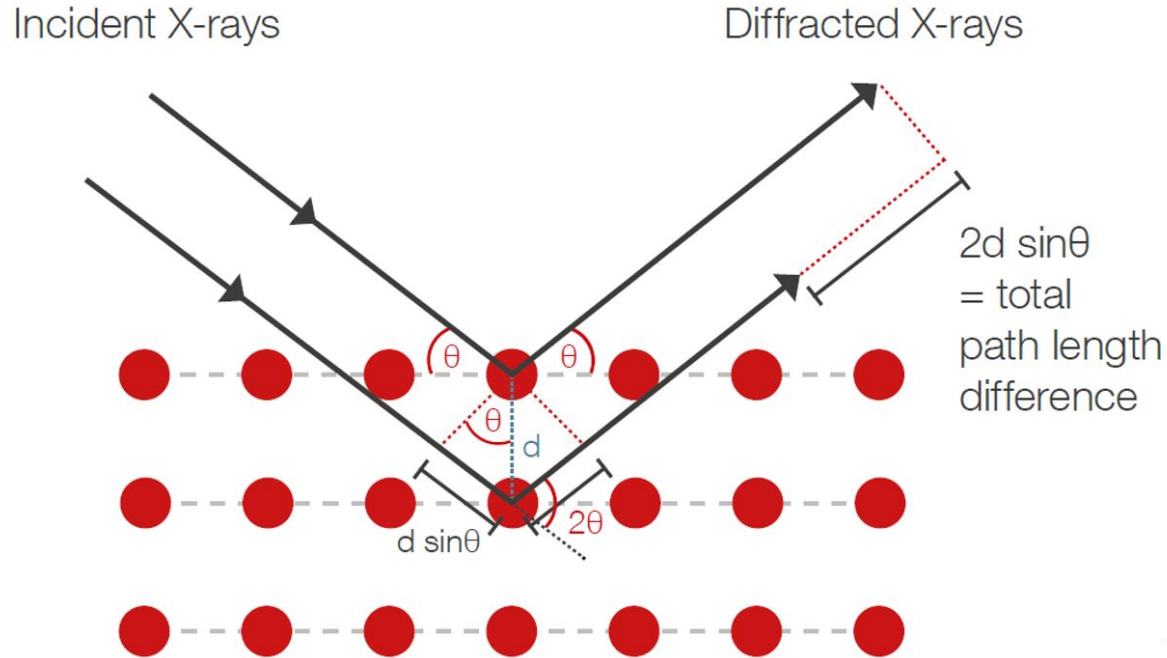
(a) Hexagonal close-packed (hcp)



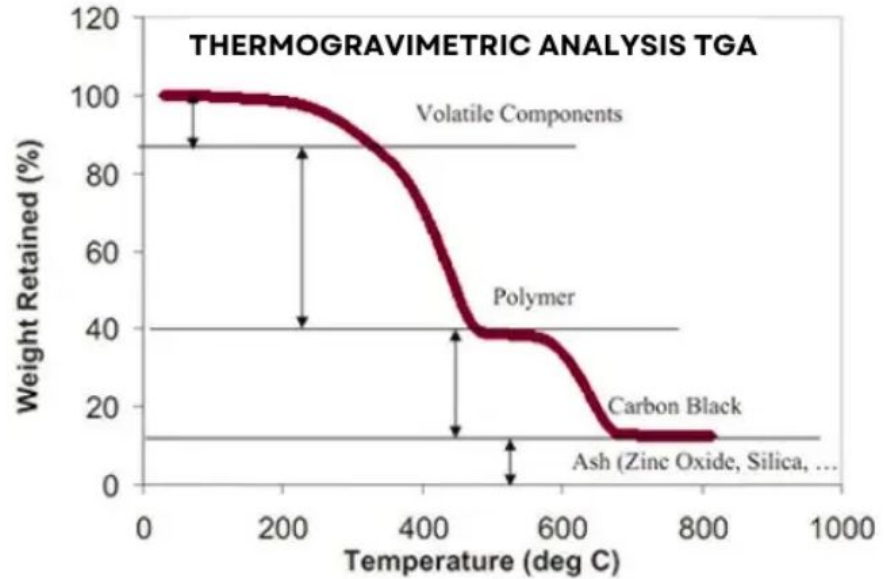
(b) Cubic close-packed (ccp)



Characterization techniques: X-ray diffraction (XRD)



Characterization techniques: Thermal gravimetric analysis (TGA)



Characterization techniques: Differential scanning calorimetry (DSC)

