formation

d graphite
on

Unit 5

Non-Ferrous metals & Alloys

Copper

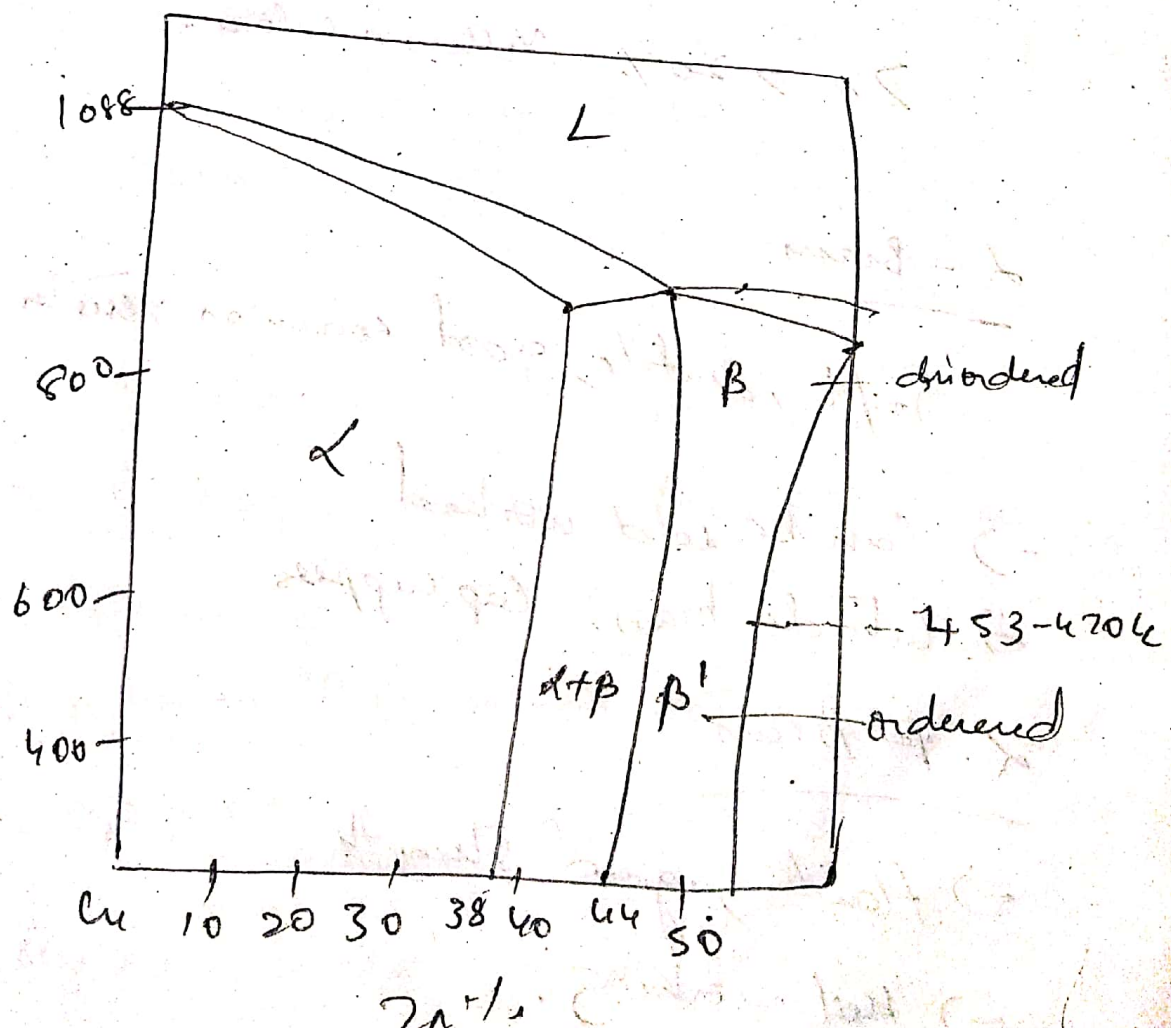
-> Crystal structure - FCC - good ductility & malleability

-> good electrical & thermal conductivity

-> Used - corrosion resistance

-> Ability to form alloys

Brass Zn + Cu



Properties

α - ductile, good strength

β - T.S ↑ ductility ↓

γ - brittle

1.) α - Brass Zn < 30%

2.) α-β Brasses Zn - (30-42%)

Zn < 20% red in colour

Zn > 20% Yellow in colour.

α - Brass

Soft, ductile, good corrosion resistance

→ Can be cold worked

⇒ Cartridge brass, Cap copper

α-β Brass

→ Hard, good strength

→ Hot working.

Muntz Metal

Zn - 40%
Cu - 60%

→ Single phase above 700°C
→ Readily hot worked & can be extruded & rolled
→ Utensils, bolts & nuts
→ Strong, hard.

Bronze

Cu-Sn

Al-Bronzes
Sn-Bronzes
Be-Bronzes

Phosphor Bronze

Cu, Sn, P

→ phosphorus is a deoxidizer
→ improves fluidity & thus improves castability
→ with in 'P' % mechanical properties get improved.

Mg P- is Brittle

1.) Wrought phosphor bronzes

2.5 – 8 % Sn

0.1 – 0.35 % P

– Springs, bushes, electrical contacts

2) Cast phospha Bronze

5 – 13 % Sn

0.3 – 1 % P

– gears, valves.

Aluminium

– FCC ductile, malleable

– thermal & conductivity

– ~~light~~ Light in wt 2.7 g/cc density

→ good deoxidizers

→ Al_2O_3 good corrosion Resistance

→ cold & Hot worked.

→ ~~Ductile~~ Ductile for most of the time

→ Good alloying ability

→ Utensils, Automobile & Aircraft.

at -40°C it's becomes Brittle

Duralumin

-> Strong / light in wt
-> Soft ductile
-> Can be extruded, no used
-> Composition
  - Mg 1%
  - Cu 4%
  - Al 95%

Applications

- Aircrafts
  Boat frames
- Lightweight guns.

Nickel

FCC, good ductility & malleability
-> white in color
-> Good corrosion Resistance
-> Can be alloyed with the other elements
-> Strength, ~~but~~ ductility not as good as pure 'Cu' & 'Al'
-> used in the production of stainless steels

Invar

alloy of Fe, Ni

Composition

Ni - 36%

Fe - 64%

generally co-effient of thermal expansion

$\leq$ of Ni%

→ almost 0 C.T.E

Applications

→ Precision instruments

Measuring tapes

length standards.

Titanium Ti alloys

→ Good strength & low density

→ Good corrosion resistance due to TiO_2

→ Retains strength at elevated temp

→ low C.T.E

Applications

→ Aircrafts, automobiles etc.

→ Marine application

Ti - alloys

Ti - allotropic forms

α - 882°C < β
HCP BCC

1) α - alloys — 5%.Al - 2.5%.Sn → Improves strength without loss of ductility → gas turbines
2) β - alloys — 13%.V - 11%.Cr - 3%.Al → good ductility & formability → gains more strength by age hardening → Boat frames.
3) Ti - 6Al - 4V — 6%.Al, 4%.V
[α-β alloys]

- 60-70% of applications
- Turbines & compressors blades & wings
- 955°C - β → Quenched - Age hardening → R.T α' starts out

Ti-6Al-4V is the most popular titanium alloy it has high strength, good creep, fatigue & corrosion resistance

Applications :-

Turbine compressor blades & wings, airframes

Age hardening of Ti-6Al-4V :-

Age hardening alloy is treated to 955°C and is transformed to complete β structure upon quenching to

obtained is metastable β structure from which α-phase ~~precipitates~~ precipitates at this stage alloy has high strength & can be further increased by ageing for 4 hours at 939°C So that two phase alloys α+β is formed.

Ceramics

→ Extremely hard & Brittle - due to ionic & covalent Bonding

→ Poor thermal & electrical conductivity

→ High melting point

→ High strength at elevated temp.

Classified

1) Crystalline ~~ceramics~~ ceramics

2) Glass ceramics - amorphous

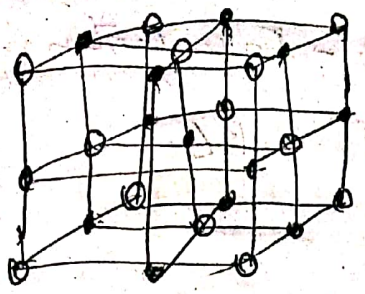
1) Crystalline ceramics

long range order

definite crystal arrangement.

(i) NaCl

two FCC



● - Na^+ atom

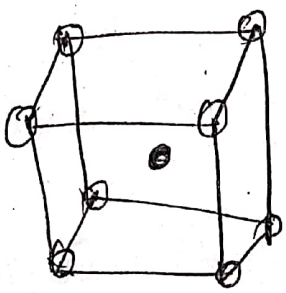
○ - Cl^- atom

Coordination no is 6

$\frac{\text{radius of } Na^+}{\text{radius of } Cl^-} = 0.59$

other elements are MgO, CaO

(ii) CsCl



● - Cs

○ - Cl

C.N is 8

$\frac{r_{Cs^+}}{r_{Cl^-}} = 0.94$

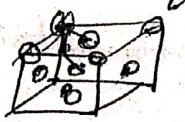
FiCl, TiBr

(iii) Zinc Blend = ZnS

C-S 4Zn, 4S atom

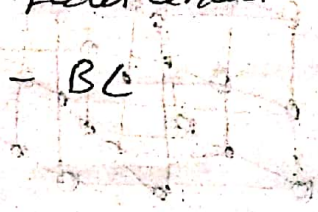
C.N is 4

Zn - latticepts of FCC S - tetrahedral voids of FCC



(iv) perovskite - ABC_3

→ $LaTiO_3$ → Ca - corners of FCC
O - Face centers
Ti - BC



→ $BaTiO_3$
> 120°C

Polymers

mer - unit
monomer - Single unit

→ polymerization
→ macromolecules

Properties

→ Highly plastic
→ Low density
→ Good corrosion resistance
→ poor mechanical properties
→ Good Mouldability
→ poor resistance to High Temp
→ Applications are limited, poor mechanical properties

Classification :-

1) Thermoplastic
   soft, weak vander wall force
   Ex :- PVC, Polystyrene, Polyethylene
   Polypropylene. are called Big 4

2) Thermosetic
   Hard,
   First heating softy

Ex Bakelite [Phenol formaldehyde]

Polymerization Methods

1) Addition polymerization —
2) Condensation polymerization — Nylon 66, Dacron
3) Co-polymerization