

MATERIALS ENGINEERING

MT30001

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Offered by:

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What type of bonding is expected for each of the following materials: brass, rubber, barium sulfide, xenon, bronze, nylon, aluminum phosphide?

Why are poly-crystalline materials mostly isotropic?

Mention two reasons why interstitial diffusion is normally more rapid than vacancy diffusion

Why are metals with HCP structure more brittle than BCC or FCC metals?

What is the magnitude of the maximum stress that exists at the tip of an internal crack having a radius of curvature of 2.5×10^{-4} mm and a crack length of 2.5×10^{-2} mm when a tensile stress of 170 MPa is applied?

A specimen of a 4340 steel alloy having a plane strain fracture toughness of $45 \text{ MPa}\sqrt{\text{m}}$ is exposed to a stress of 1000 MPa . Will this specimen experience fracture if it is known that the largest surface crack is 0.75 mm long? Assume that the parameter Y has a value of 1.0 .

Mention two non-destructive testing methods used to detect the internal flaws in a material

A fatigue test was conducted in which the mean stress was 50 MPa and the stress amplitude was 225 MPa.

(a) Compute the maximum and minimum stress levels.

(b) Compute the stress ratio.

List four measures that may be taken to increase the resistance to fatigue of a metal alloy

If creep becomes important at temperatures $> 0.4T_m$, mention the approx. temperatures for creep in the metals nickel, copper, iron, tungsten, lead, and aluminum

Cite three variables that determine the microstructure of an alloy at room temperature

A copper-nickel alloy of composition 70 wt% Ni-30 wt% Cu is slowly heated from a temperature of 1300°C .

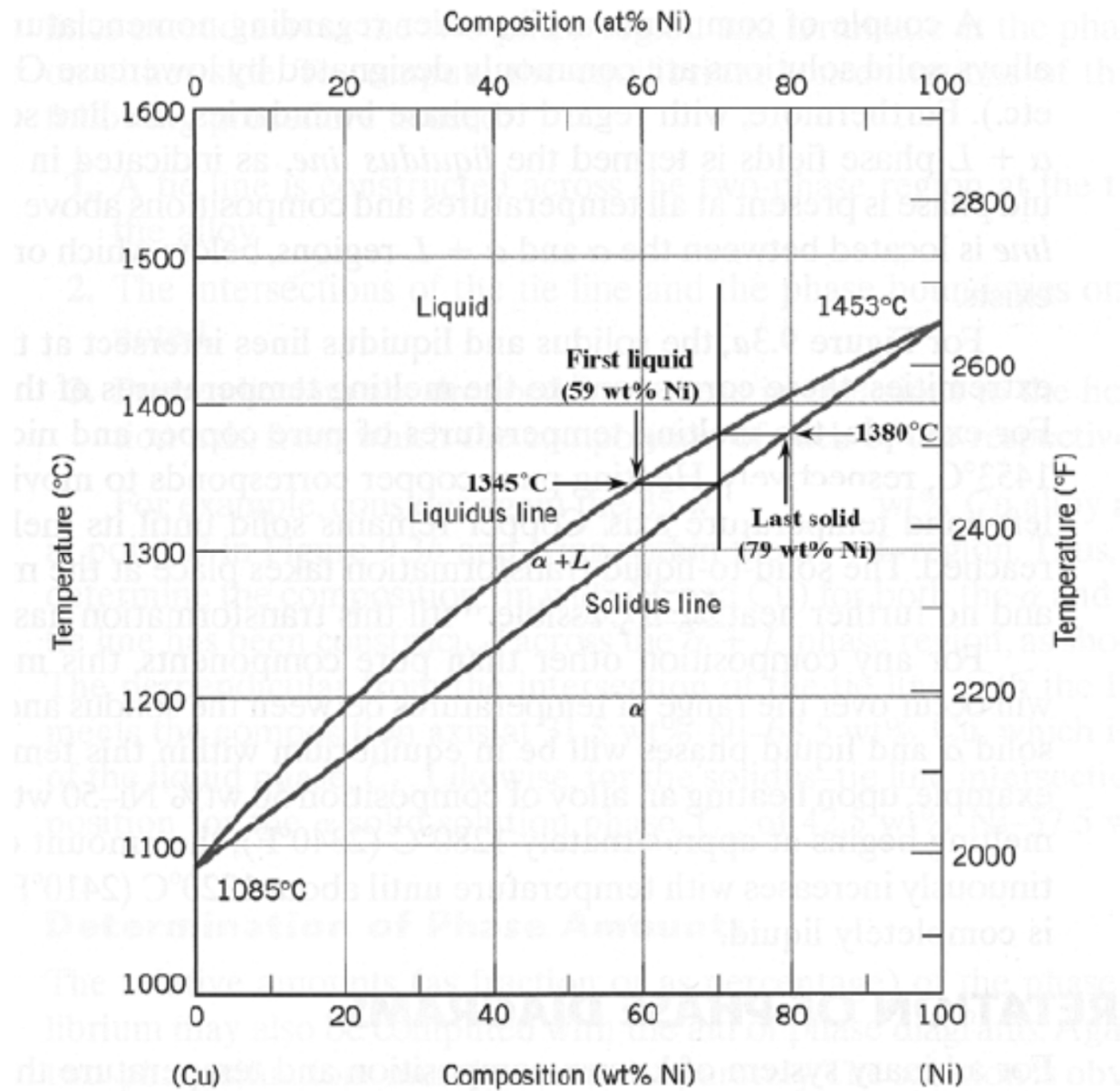
(a) At what temperature does the first liquid phase form?

(b) What is the composition of this liquid phase?

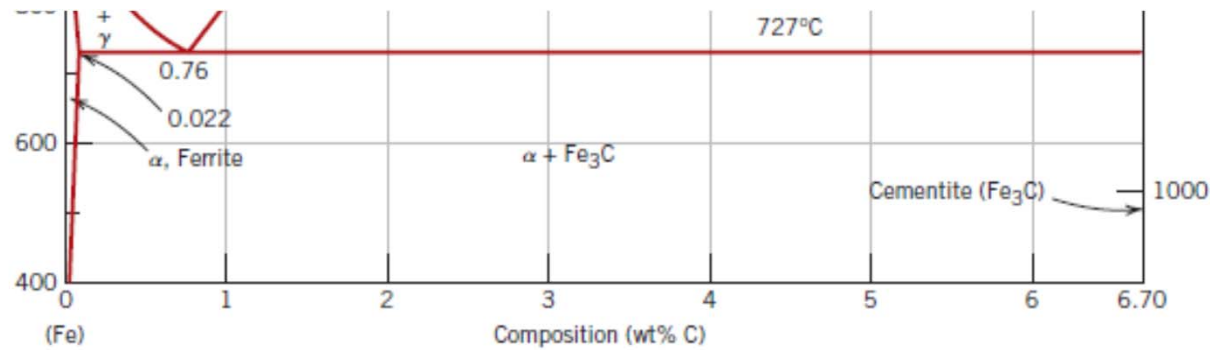
(c) At what temperature does complete melting of the alloy occur?

(d) What is the composition of the last solid remaining prior to complete melting?

Refer to phase diagram in the next slide



Compute the mass fractions of α ferrite and cementite in pearlite at room temperature



In a hypoeutectoid steel, both eutectoid and proeutectoid ferrite exist. Explain the difference between them.

Briefly explain why fine pearlite is harder and stronger than coarse pearlite, which in turn is harder and stronger than spheroidite.

Rank the following iron–carbon alloys and associated microstructures from the highest to the lowest tensile strength:

- (a) 0.25 wt%C with spheroidite,*
- (b) 0.25 wt%C with coarse pearlite,*
- (c) 0.60 wt%C with fine pearlite, and*
- (d) 0.60 wt%C with coarse pearlite.*