TMT 4185 – Øving 6

9.21
Is it possible to have a copper–silver alloy of composition 20 wt% Ag–80 wt% Cu that, at equilibrium, consists of α and liquid phases having mass fractions W_α=0,80 and W_L=0.20? If so, what will be the approximate temperature of the alloy? If such an alloy is not possible, explain why.

9.25
(a) Briefly describe the phenomenon of coring and why it occurs.
(b) Cite one undesirable consequence of coring.

9.32
For a lead–tin alloy of composition 80 wt% Sn–20 wt% Pb and at 180°C do the following:

- **(a)** Determine the mass fractions of α and β phases.
- **(b)** Determine the mass fractions of primary β and eutectic microconstituents.
- **(c)** Determine the mass fraction of eutectic β.

9.37
For a 52 wt% Zn–48 wt% Cu alloy, make schematic sketches of the microstructure that would be observed for conditions of very slow cooling at the following temperatures: 950°C, 860°C, 800°C and 600°C. Label all phases and indicate their approximate compositions.

9.43
Figure 9.37 is a portion of the copper-aluminum phase diagram for which only single-phase regions are labeled. Specify temperature–composition points at which all eutectics, eutectoids, peritectics, and congruent phase transformations occur. Also, for each, write the reaction upon cooling.

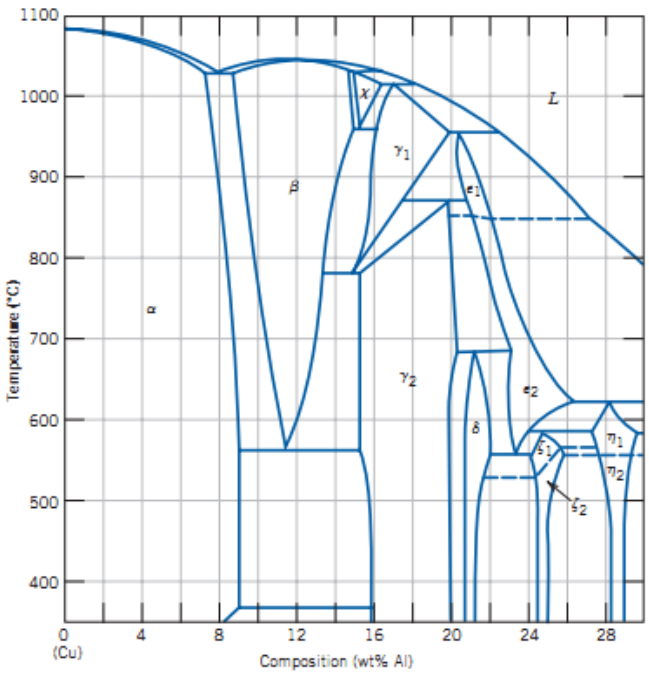

Figure 9.37 The copper–aluminum phase diagram. (Adapted with permission from *Metals Handbook*, 8th edition, Vol. 8, *Metallography Structures and Phase Diagrams*, American Society for Metals, Metals Park, OH, 1973.)

9.47

(a) What is the distinction between hypoeutectoid and hypereutectoid steels?

(b) In a hypoeutectoid steel, both eutectoid and proeutectoid ferrite exist. Explain the difference between them. What will be the carbon concentration in each?

9.50

Consider 3.5 kg of austenite containing 0.95 wt% C, cooled to below 727°C.

(a) What is the proeutectoid phase?

(b) How many kilograms each of total ferrite and cementite form?

(c) How many kilograms each of pearlite and the proeutectoid phase form?

(d) Schematically sketch and label the resulting microstructure.

9.63

For an iron–carbon alloy of composition 3 wt% C–97 wt% Fe, make schematic sketches of the microstructure that would be observed for conditions of very slow cooling at the following temperatures: 1250°C, 1145°C and 700°C. Label the phases and indicate their compositions (approximate).

Oppgave 1

(*English version on next page*)

a)

Ulegert jern foreligger i to forskjellige krystallstrukturer avhengig av omgivelsestemperaturen. Skisser enhetscellen for disse krystallstrukturene. Angi hvilken struktur man vil ha ved romtemperatur.

b)

Utled et uttrykk for gitterkonstanten (a) som funksjon av atomradius R for et materiale med en FCC struktur. Aluminium har FCC struktur. Bestem gitterkonstanten (a) for aluminium når atomradiusen for aluminium (Al) er 0,1431 nm.

c)

Løseligheten av karbon i fast jern er avhengig av krystallstrukturen, noe som kan observeres i fasediagrammet for Fe-Fe3C (se Figur 1). Hvilken krystallstruktur har størst løselighet i fast fase (begrunn svaret)? Hvor stor er den maksimale løseligheten av karbon i fast jern og ved hvilken temperatur finner dette sted?

Fasediagram for systemet Fe-Fe3C er vist på neste side.

Exercise 1

a)

Non-alloyed iron may have two different crystal structures, depending on the surrounding temperature. Sketch the unit cells for these two crystal structures. Which structure is present at room temperature?

b)

Derive an expression for the lattice constant ”a” as a function of the atomic radius R for a material with an FCC structure. Determine the lattice constant for aluminium (Al) which has an atomic radius of 0.1431 nm.

c)

The solubility of carbon in iron is dependent on the crystal structure, which can be observed from the phase diagram for the Fe-C system (see Figure 1). Which of the crystal structures has the highest solubility in solid state and why (explain). What is the maximum solubility of carbon in solid iron and at what temperature does this take place?

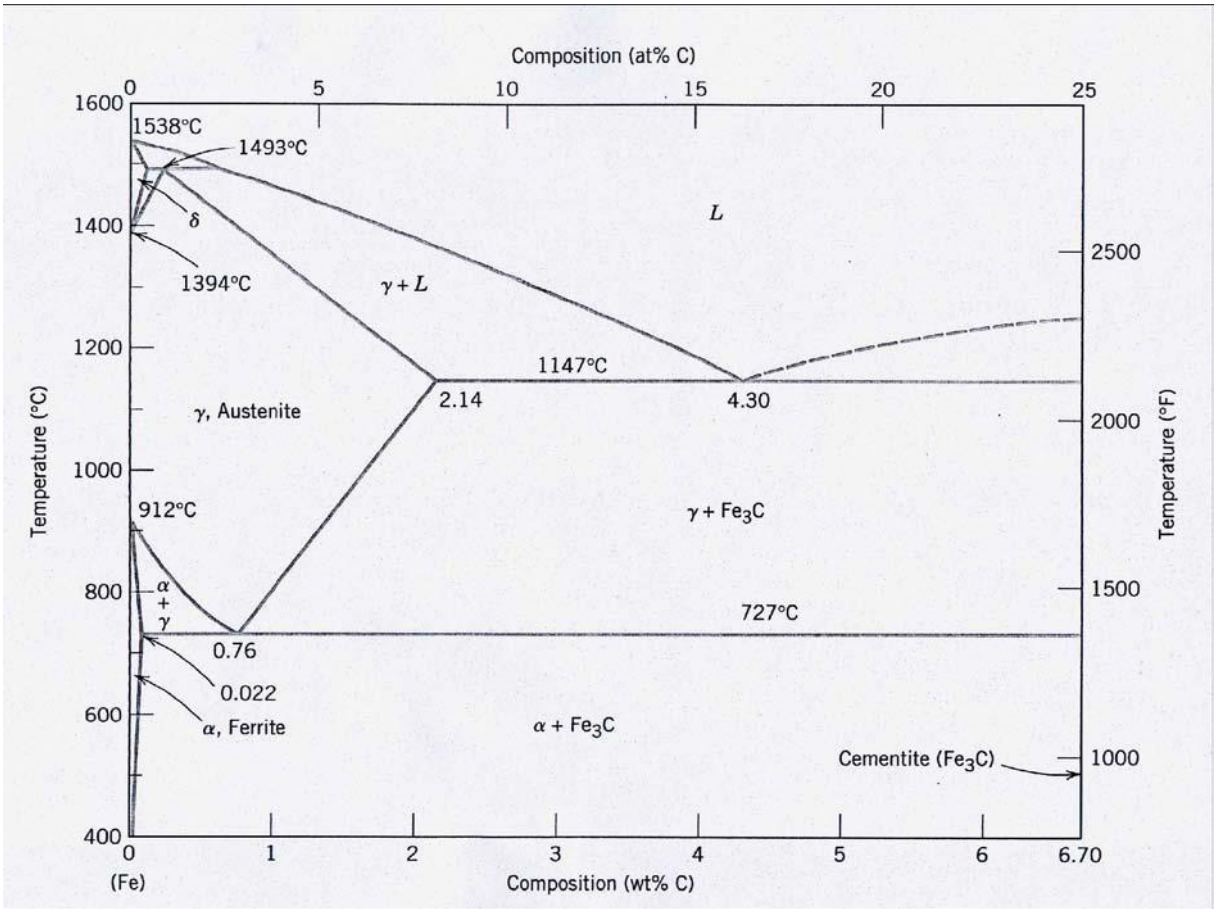

Figure 1: Phase diagram for the Fe-Fe3C system.