3.

中正大學機械系 99 學年度上學期工程材料學期末考試題 100.1.13

1.可用計算機 2.不可用字典 3.Close-book 4. Total score: 120 敖仲寧老師

1. Draw a Fe-Fe_3C equilibrium phase diagram of ferrous alloys. Indicate (1) all phases, (2) temperatures, (3) wt% of carbon at relevant points or lines. (20%)

2. Continued from question 1, consider an austenitic microstructure containing 0.65 wt% C, cooled from γ phase to slightly below 727°C,
   (a) What is the pro-eutectoid phase? Determine the mass fraction of the pro-eutectoid phase. (6%)
   (b) Determine the mass fraction of pearlite. (6%)
   (c) Determine the mass fraction of total ferrite and cementite? (8%)

3. Figure 3a shows a Pb-Sn phase diagram. (25%)
   (a) If the micrograph in fig. 3b reveals the microstructure of a Pb-Sn alloy containing 80% of Sn, what is the phase shown as dark circular area? How much % of Sn does this phase contain? Determine the mass fraction of this phase. (8%)
   (b) What do we call the phase consisting of lamellar dark and bright layers? How much % of Sn does this phase contain in average? (4%)
   (c) Continued from (b), what is the phase shown as the bright area? How much % of Sn does this phase contain? Determine the mass fraction of this phase. (8%)
   (e) Which area is the pro-eutectic phase? What is the advantage of a nearly eutectic Pb-Sn alloy applied extensively in the electronic industry? (5%)

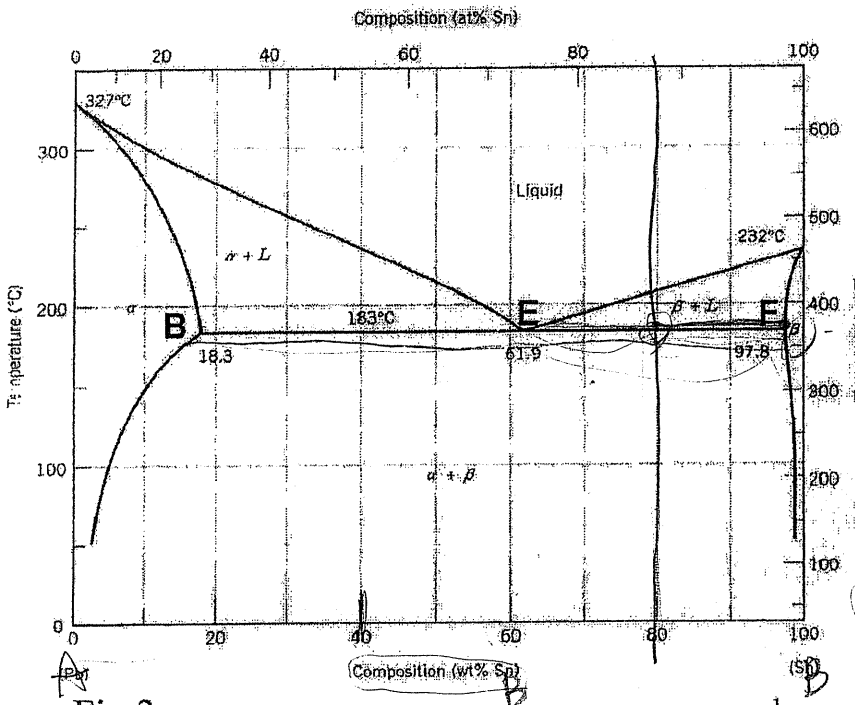

Fig.3a

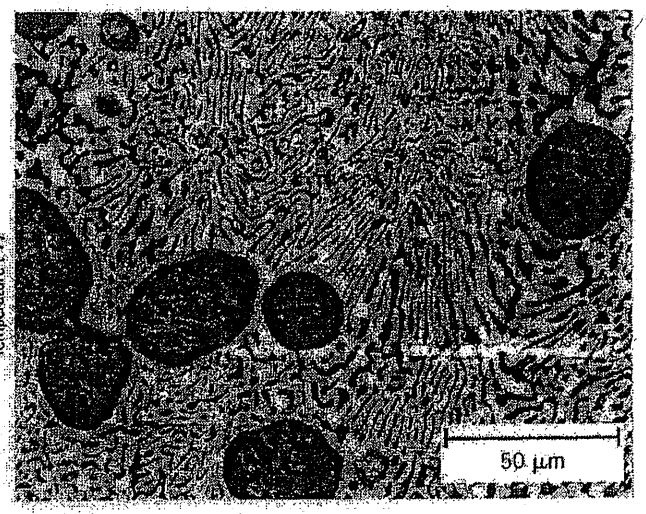

Fig.3b

4. For ***eutectic*** alloys consisting of two hypothetical metal elements A and B having a similar phase diagram as fig.3a, there exist an α phase riched in metal A and a β phase riched in B. From the mass fractions of both phases for two different alloys 1 and 2 shown in the table below, (which are at the same temperature), determine the composition of the phase boundary (or solubility limit) for both α and β phases at this temperature. (10%)

Table for question 3

Alloy	Alloy Composition	Mass Fraction α Phase	Mass Fraction β Phase
1	60 wt% A–40 wt% B	0.57	0.43
2	30 wt% A–70 wt% B	0.14	0.86

5. Plot schematically a temperature-versus-time curve to show the two successive heat treatment steps for precipitation hardening of an aluminum alloy. Also briefly explain the principle of the precipitation hardening. (10%)

6. Phase diagram and microstructure (15%)

(a) Label the phase areas in fig.6. (5%)

(b) What is the reaction at point P when cooled from higher temperature? (5%)

(c) Plot schematically the microstructure formed at point P and indicate the features of the microstructure with proper phase label. Submit fig.6 with answer sheets. (5%)

7. Identify the microstructures in fig.7 and label them directly on fig. 7 and submit fig.7 with answer sheets. (20%)

(a) shows the microstructure of a low carbon steel. What is the white area? What is the dark area? (5%)

(b) shows the microstructure of a hyper-eutectoid steel. What is the bright phase on grain boundaries? What is the phase having a lamellar feature? What is the white lamellar phase? (5%)

(c) What kind of cast iron is 7(c)? What is the white area? What are the dark strips? (5%)

(d) What kind of cast iron is 7(d)? What is the white area? What is the lamellar area? (5%)