

國立虎尾科技大學 102 學年度第一學期博士班資格考試題

所別：動力機械工程系機械與機電工程博士班

第 1 頁 共 3 頁

科目：Engineering materials 【close book examination】

注意事項：

- (1) 本試題共有 5 題，任選 5 題作答，每題 20 分，合計一百分。
- (2) 請依序作答於答案卷上並註明題號，若未註明選答題號及超過規定題數時，謹採計作答順序較前之題目計分。
- (3) 可使用計算機

1. Fe-Fe₃C phase diagram is shown in Figure 1, answer fellow questions according to this diagram.

- (a) 0.6wt%C hypoeutectoid plain-carbon steel is slowly cooled from austenite region to a temperature just slightly below 727°C; calculate the weigh percent (wt %) of proeutectoid ferrite and eutectoid ferrite present in the steel. (6%)
- (b) Plain-carbon steel is slowly cooled from austenite region to a temperature just slightly below 727°C; assume the amount of proeutectoid phase is equal to the amount of eutectoid phase, what is the carbon content of the steel? (6%)
- (c) 0.4wt%C hypoeutectoid plain-carbon steel and 1.2wt%C hypereutectoid plain-carbon steel were spheroidized treatment by spheroidizing, the result phases contain ferrite (matrix) and spheroidite(cementite); calculate respectively the weight percent (wt %) of ferrite and spheroidite for these steels. (6%)
- (d) Write the allotropic transformations which occur in the Fe-Fe₃C diagram. (2%)

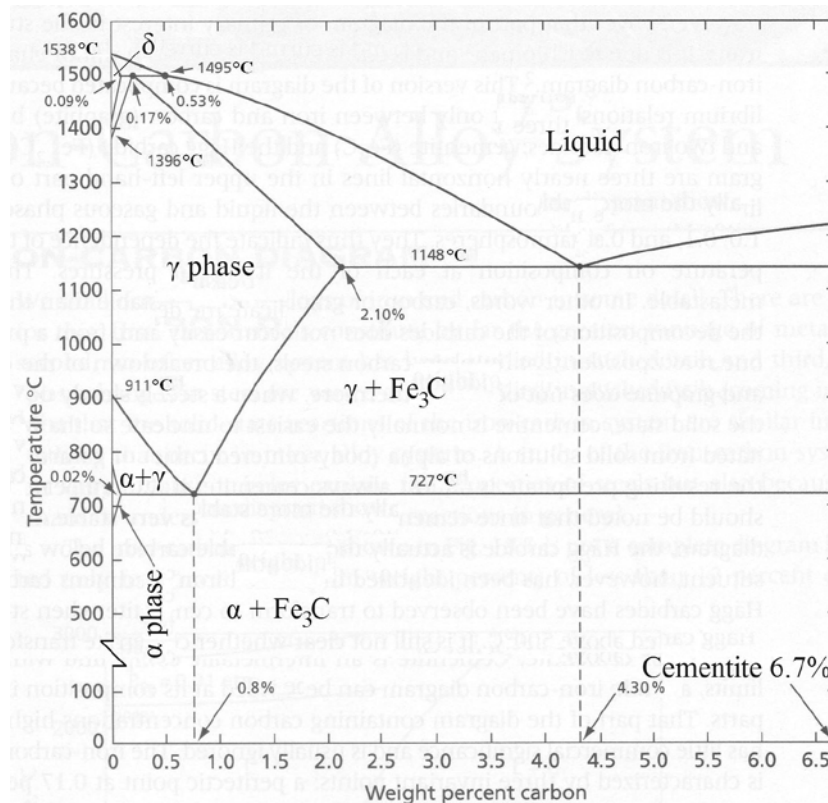


Figure 1

2. Aluminum-rich end of Al-Cu alloy equilibrium diagram is shown in Figure 2, Al-4(wt) %Cu wrought aluminum alloy was concerned in fellow questions.
 - (a) How to carry out strengthening heat treatment for Al-4(wt) %Cu wrought aluminum alloy? Describe the heat treatment processes in detail. (8%)
 - (b) Sketch aging hardening curves (relationship between hardness-aging time at constant temperature) and explain the effect of temperature on hardening curves. (6%)
 - (c) Explain the precipitation sequences to match the hardening curve. (6%)

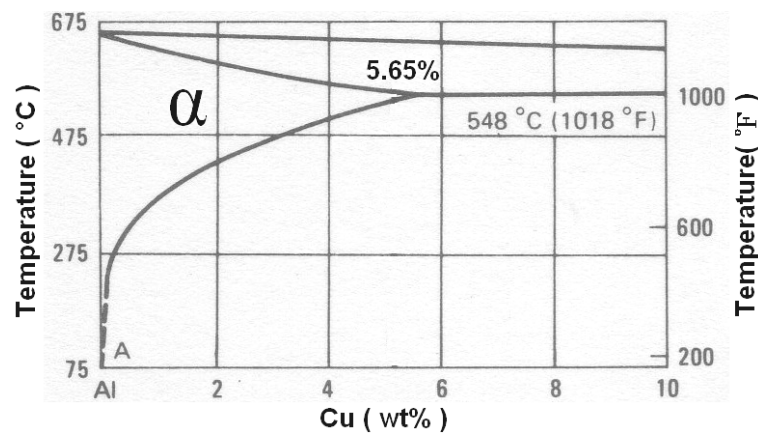
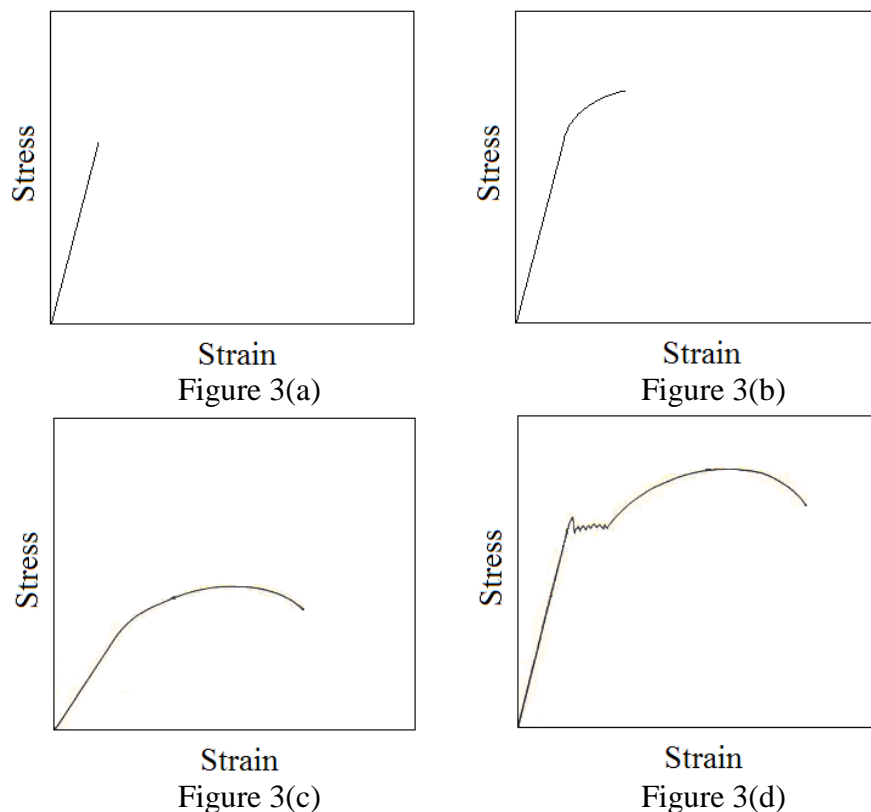


Figure 2

3. On the basis of compositional and structural differences, wrought stainless steels are divided into four main groups (types), answer fellow questions.
 - (a) List the four main groups (types) of stainless steels; describe their principal characteristics and properties. (8%)
 - (b) What is “intergranular corrosion” in austenitic stainless steel? How to prevent “intergranular corrosion”? (8%)
 - (c) Why as-extruded austenitic stainless steel (e.g. AISI 304) seamless pipe is magnetic? (4%)

4. The result (strain-stress) curves of tensile test for four different materials are shown in Figure3 (a) (b) (c) (d); we know that four materials are plain-carbon steel, aluminum alloy, ductile cast iron and ceramics in tensile test, answer fellow questions.
 - (a) To match the Figure 3 and material depending on curve profile, and explain your answer in detail. (8%)
 - (b) Strain-stress curve has no distinct yielding point in Figure 3(c); describe how to decide the yielding stress? And strain-stress curve shows yielding phenomenon in Figure 3(d), explain this phenomenon. (6%)
 - (c) Describe how to compare the toughness and also list the toughness rank from the result curves of tensile test for the above mentioned materials. (6%)



5. Describe the strengthening methods and explain the strengthening mechanisms in engineering materials. (20%)