

# 國立臺北科技大學九十九學年度碩士班招生考試

系所組別：3302 材料科學與工程研究所

## 第二節 物理冶金 試題 (選考)

第一頁 共一頁

### 注意事項：

1. 本試題共九大題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Compare and describe the migration mechanisms of screw and edge dislocations (10%).
2. Describe the conditions and processes to form equilibrium precipitates with characteristic shapes (such as needle- or plate-shaped precipitates). (10%)
3. Given that the energy for nucleation is  $A r^3 + B r^2$ , answer the following: (total 30%)
  - (1) Please explain the meanings of A, B, and r. (10%)
  - (2) Please sketch the variations of two terms with "r" in the above nucleation energy. (5%)
  - (3) Derive the critical size of nuclei and nucleation energy. (5%)
  - (4) Please discuss the effects of temperature upon nucleation via the above nucleation energy. (5%)
  - (5) Explain the effects of heterogeneous nucleation site upon the above equation and the equilibrium size of nuclei. (5%)
4. Propose four mechanisms that barricades dislocation movements and explain how they might affect the mechanical properties of metals. (10%)
5. Compare CCT with TTT curves of steels, which curve initiates transformation earlier than the other? Explain why. (10%)

6. Please choose one that is incorrect: (5%)
  - (1) Dendritic segregation is a kind of microsegregation.
  - (2) Zone melting for silicon purification is attained via the principles of segregation.
  - (3) In practice, slow cooling can produce a casting completely free of segregation.
  - (4) There are normally concentration variations inside each grain of solidified castings.
7. Please choose one statement that is correct: (5%)
  - (1) Steady-state creep is achieved by a balance between dynamic recovery and strain hardening.
  - (2) There is no obvious difference in the fatigue properties of air melted and vacuum melted steels.
  - (3) Metals in their solid state are always more ductile at higher temperatures.
  - (4) Microstructures containing some large grained metals are always softer and more ductile.
8. Please choose the ones that are correct: (10%)
  - (1) For the same crystal structure, the atomic planes with lower planar densities grow slower.
  - (2) For the same crystal structure, the low-indexed atomic planes normally grow slower.
  - (3) The activation energy for carbon diffusion in  $\gamma$ -Fe is higher than that in  $\alpha$ -Fe.
  - (4) The activation energy for nitrogen diffusion in pure iron is higher than that in niobium.
  - (5) Recrystallization temperature is fixed for a specific metal.
  - (6) Glass transition temperature is fixed for a specific metal.
9. Which of the following factors can affect recrystallization grain size? (10%)
  - (1) Cooling rate after annealing.
  - (2) Cold work percentage.
  - (3) Precipitation.
  - (4) Purity.
  - (5) Atmosphere.
  - (6) Annealing temperature.