

八十四學年度材料科學工程研究所 組碩士班研究生入學考試

科目 物理冶金(I) 科號 120 / 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

1. On a schematic diagram of atomic energy levels, show (a) the electron transition process of $K_{\alpha 1}$ characteristic x-ray emission, and (b) the KL_1L_1 Auger electron transition. (c) Can you use Auger analysis to detect the hydrogen in a sample? Explain why. (3%, 3%, 4%)

2. Suppose the active slip system in a FCC crystal is $(11\bar{1})[101]$.
 - (a) Write down the Burgers vector for the total dislocation causing slip. (2%)
 - (b) What is the direction of dislocation line if slip occurs by the motion of a pure edge dislocation? (2%)
 - (c) What is the direction of dislocation line if slip occurs by the motion of a pure screw dislocation? (2%)
 - (d) What is the direction in which the dislocation line would move during slip in the above case (b), and (c)? (4%)
 - (e) Suppose a tensile stress 100 MPa is imposed in the $[321]$ direction and the critical resolved shear stress is 60 MPa, will the dislocation move? (5%)

3. (a) Write down the general relationship between the flow stress (τ) and the dislocation density (ρ). (2%)
 - (b) Explain why this relation holds. (8%)

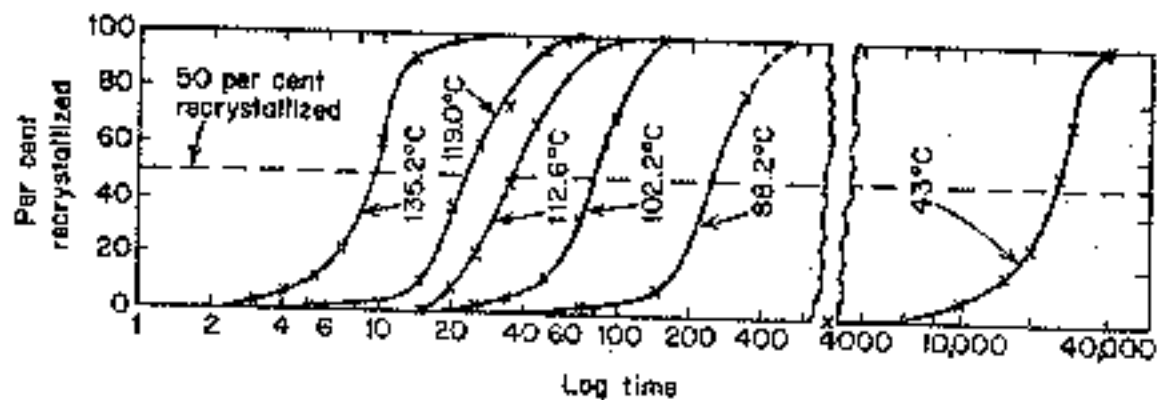
4. (a) When dynamic recovery occurs, how will the effective work hardening rate change? (2%)
 - (b) What is the primary mechanism involved in dynamic recovery? (3%)
 - (c) Discuss how the temperature would affect the occurrence of dynamic recovery? (5%)
 - (d) Discuss how the magnitude of stacking fault energy of FCC metals would affect the occurrence of dynamic recovery? (5%)

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科目 物理冶金(I) 科號 1201 共 3 頁第 2 頁 *請在試卷【答案卷】內作答

(中、英文作答均可，以英文作答者若文意不清楚而致改題時誤判，自己負責)

5. 材料製備上，有無可能製得dislocation含量為零之單晶(2%)？何故(2%)？有無可能製得vacancy含量為零之單晶(2%)，何故(4%)？
6. 圖II-1為純銅(99.999%)經98%冷加工後，於所示各不同溫度恆溫時之再結晶百分率變化曲線，試根據它繪出代表0%、50%、100%再結晶量之T-T-T曲線(9%)；並據此求出再結晶最快之溫度值(1%)。



圖II-1

7. 下面兩問與固溶體有關，請簡單作答：
- (a) 同一溫度下、達成平衡，則被石墨包圍之肥粒鐵 (ferrite) 跟被雪明碳鐵包圍之肥粒鐵 (體積相同)，何者碳濃度較高(1%)？何故(3%)？
- (b) 繪一簡圖，說明一螺旋差排 (screw dislocation) 之剪應力場(3%)，寫出並說明剪應力大小 (τ) 與差排中心距離 (r) 關係(3%)。

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科目 物理冶金(I) 科號 1201 共 3 頁第 3 頁 *請在試卷【答案卷】內作答

8. 圖II-2 為很常見之Cu-Zn二元相圖，請指出所有包晶 (peritectic) 及包析 (peritectoid) 型反應，需以相圖上之相符號，寫出該反應式，註明反應溫度及約略成分 (Zn 含量之原子%)。(10%)

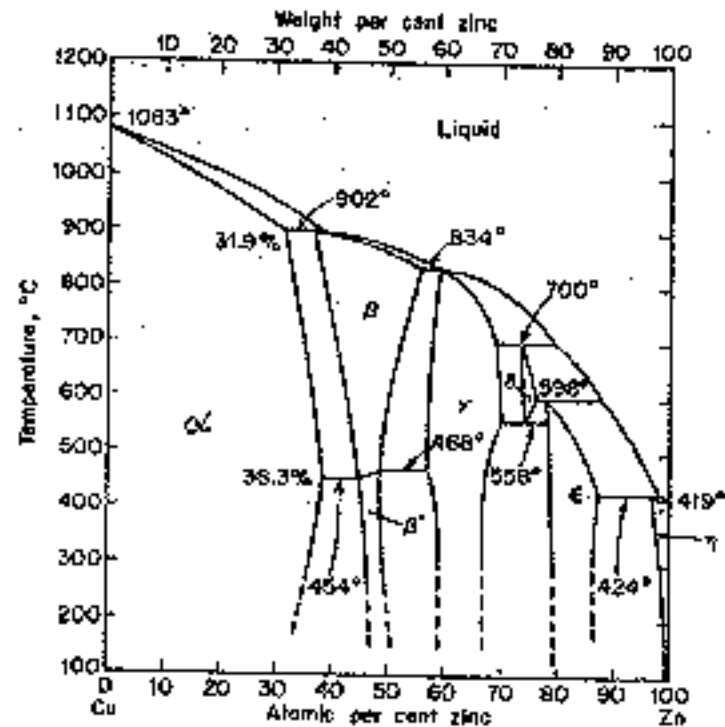


圖 II-2

9. 圖II-3 為水之三相圖，在材料製程上，可利用它進行冷凍乾燥-- 一種不須加熱，反而用冷凍，可將水除乾，得到陶瓷粉體的方法，試在你的答案紙上複製此圖，並繪出冷凍乾燥途徑，加以簡單說明 (6%)；試以相律 (phase rule) 說明點A之相種類及自由度 (4%)。

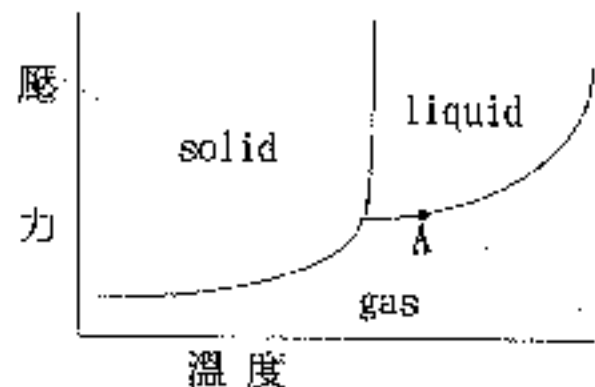


圖 II-3