國立成功大學八十三學年度碩士班入學考試(機械材料與機械製造(機械材料)試題) 共 二 頁 第 一 頁

part 工、機械材料試題

一、填充題：20%

1．FCC結構中每單位晶胞內包含__(1)__個八面體(octahedral sites)；在BCC結構中每單位晶胞內包含__(2)__個四面體(tetrahedral sites)．

2．不銹鋼內之主要合金元素為__(3)__；高速鋼內之主要合金元素為__(4)__．

3．消除材料淬火後之內應力並增加其韌性之熱處理操作稱為__(5)__處理．

4．欲使滑動面上下層原子產生滑移時，理論上所需之臨界剪應力 τ=__(6)__．

5．固溶體依溶質原子之大小可區分為__(7)__與__(8)__兩種類型．

6．氧化電位甚高之金屬於腐蝕之環境腐蝕後，生成緻密之保護層阻止後來之腐蝕發生，此種現象稱為__(9)__．

7．金屬中導電度及導熱度最高者係__(10)__．

二．問答及計算題：30%

1．試計算BCC晶格中(110)平面及FCC晶格中(111)平面之原子密度．(4%)

2．何謂差排之三個特性向量？如何據以分辨出刃差排(edge dislocation)及螺旋差排(screw dislocation)．(4%)

3．試簡述影響雙晶(twins)形成之四大要素．(4%)

4．何謂配位數(coordination number)？試以原子模型圖示FCC結構之配位數為若干？(4%)

5．何謂深冷處理(sub-zero treatment)？試舉一應用實例說明深冷處理之重要性．(4%)

6．均質成核(Homogeneous nucleation)與非均質成核(heterogeneous nucleation)有何不同？試從自由能之觀點解釋之．(4%)

7．一含碳0.25wt%之碳鋼，置於2.5wt%碳濃度之環境中於950°C中作表面硬化處理，今欲使其在距表面0.5mm處之碳含量達0.8wt%，試問需時若干？(6%)

已知：a)碳於950°C在鐵中之擴散係數 $D=1.6\times10^{-11}\ m^2/s$

b)Error function values

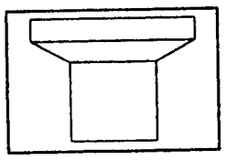
Z	erf(Z)
0.25	0.2763
0.30	0.3286
0.35	0.3794
0.40	0.4284
0.45	0.4755

part 五、機械製造

1. State five broad categories of processing methods for materials. List various techniques used in each category. Address the process characteristics, the equipment used, and the products manufactured by each technique. (10%)

2. Establishing design guidelines can help quantify design analysis for CAD/CAM applications and result in significant cost savings. Please identify significant design guidelines in casting processes pertaining to shrinkage, tolerances, draft, allowances, parting lines, flat areas, corners, angles, and section thickness. (10%)

3. Select a manufacturing process and organize the production facilities to manufacture a cost-competitive, high-quality product, as shown in the following figure. Assume that the part is round, 5 in. long, and that the large and small diameters are 1.5 in. and 1 in., respectively. List different processes and select the best one for producing the part with a selected type of material, production rate, surface finish, dimensional accuracy and cost-competitiveness. (10%)



4. Find the maximum reduction per pass of a wire drawing process. Assume the wire is made of a perfectly plastic material. (10%)

5. Compute and Compare the energy requirement for forming and machining the same part. Assume that you are given two pieces of annealed 304 stainless steel rods, each 0.500 in. in diameter and 6 in. in length. You are asked to reduce the diameter to 0.480 in., one piece by pulling it in tension, and the other by machining it on a lathe in one pass. Note that the average value for the specific energy in machining stainless steels is 1.5 hp.min/in^3. The specific energy in a forming process is $u = \int_0^{\varepsilon} \sigma \, d\varepsilon$. The natural stress-strain curve of the stainless steel is $\sigma = K\varepsilon^n$; where the strength coefficient K = 185,000 psi, the strain-hardening exponent n = 0.45, and the true strain is defined as $\varepsilon = \ln\left(\frac{L}{L_0}\right) = \ln\left(\frac{A_0}{A}\right) = \ln\left(\frac{D_0}{D}\right)^2$. (10%)