大同大學 104 學年度(暑)轉學入學考試試題

考試科目:材料導論　　系別:材料工程學系　　第1頁

註:本次考試 不可以參考自己的書籍及筆記； 不可以使用字典； 可以使用計算器。

1. **Definition** and **Cite** the difference
   (a) substitutional and interstitial solid solutions (4%)
   (b) mechanical and annealing twins. (4%)

2. The wear resistance of a steel gear is to be improved by hardening its surface. This is to be accomplished by increasing the **carbon** content within an outer surface layer as a result of carbon diffusion into the steel (**γ-iron**); the carbon is to be supplied from an external carbon-rich gaseous atmosphere at an elevated and constant temperature. The initial carbon content of the steel is 0.20 wt%, whereas the surface concentration is to be maintained at 1.00 wt%. For appropriate 1000℃ heat treatment, **how long** will it take to achieve a carbon content of 0.60 wt% at a position 0.75 mm below the surface. (10%)

Diffusion Species	Host Metal	D_0 (m^2/s)	Q_d (J/mol)
C	Fe (γ-FCC)	2.3×10^{-5}	148,000

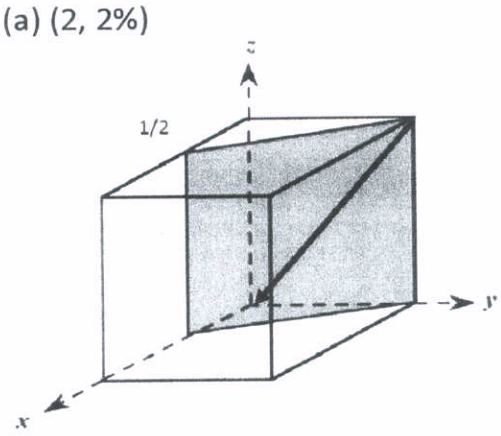
z	erf(z)	z	erf(z)	z	erf(z)
0	0	0.55	0.5633	1.3	0.9340
0.025	0.0282	0.60	0.6039	1.4	0.9523
0.05	0.0564	0.65	0.6420	1.5	0.9661
0.10	0.1125	0.70	0.6778	1.6	0.9763
0.15	0.1680	0.75	0.7112	1.7	0.9838
0.20	0.2227	0.80	0.7421	1.8	0.9891
0.25	0.2763	0.85	0.7707	1.9	0.9928
0.30	0.3286	0.90	0.7970	2.0	0.9953
0.35	0.3794	0.95	0.8209	2.2	0.9981
0.40	0.4284	1.0	0.8427	2.4	0.9993
0.45	0.4755	1.1	0.8802	2.6	0.9998
0.50	0.5205	1.2	0.9103	2.8	0.9999

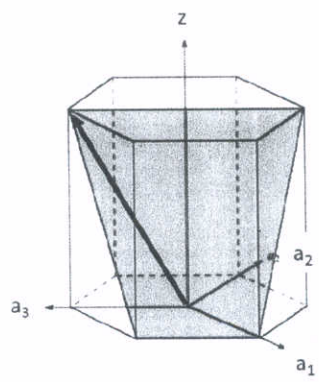
3. Make **comparisons** of thermoplastic and thermosetting polymers (4*2%)
   (a) on the basis of mechanical characteristics upon heating
   (b) according to possible molecular structures.

4. Identify crystal structures: Body-Centered Cubic (BCC) and Face-Centered Cubic (FCC). (*r*: radius of sphere and *a:* length of cube side) (2*8%)

Crystal Structure	**Atom/ unit cell**	**the relation between *r* and *a***	**Coordination number**	**Atomic packing factor (APF)**
BCC	(1)	(2)	(3)	(4)
FCC	(5)	(6)	(7)	(8)

5. Determine the Miller indices for the **direction** and **plane** shown in the following unit cell:
   (a) (2, 2%)　　(b) (2, 2%)





大同大學 104 學年度(暑)轉學入學考試試題

考試科目: 材料導論　　系別:材料工程學系　　第2頁

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6. Define the following terms. (12%)
   (a) pearlite, (b) recrystallization, (c) slip systems

7. (a) Plot a typical tensile engineering stress-strain behavior to fracture of a metal. (4%)
   (b) Plot a typical tensile true stress-strain behavior to fracture of a metal. (4%)
   (c) Indicate the proportional limit and the yield strength at a strain offset of 0.002 in (a). (4%)
   (c) Indicate the tensile strength in (a). (2%)

8. Increasing the impurity concentration of a metal results in an increase in mechanical strength. Why? (6%)

9. What is the difference in concept between "fracture strength" and "fracture toughness"? (6%)

10. Plot a typical two-component (A and B) phase diagram containing a eutectoid reaction. (6%)

11. Correct the following statement: The rate of a phase transformation increases with the increasing temperature. (6%)