國立交通大學 107 學年度碩士班考試入學招生試題

科目：物理冶金(3143)　　考試日期:107年2月2日 第 4 節

系所班別：材料科學與工程學系　　組別：材料系甲組　　第 / 頁,共 2 頁

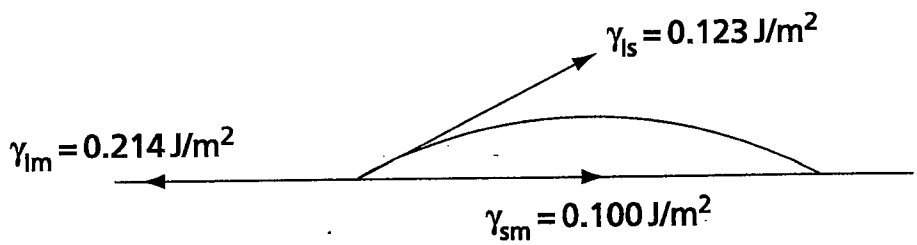
【可使用計算機】＊作答前請先核對試題、答案卷(試卷)與准考證之所組別與考科是否相符！！

1. Iron has a BCC structure at room temperature. When heated, it transforms from BCC to FCC at 1185 K. The atomic radii of iron atoms at this temperature are 0.126 and 0.129 nm for BCC and FCC, respectively. What is the percentage volume change upon transformation from BCC to FCC? (10%)

2. A typical cross-head speed in a tensile testing machine is 0.5 cm/min.
   (a) What is the nominal engineering strain rate imposed by this cross-head speed on a typical engineering tensile specimen with a 5 cm gage length? (5%)
   (b) Estimate the dislocation velocity that would be obtained at this strain rate in an iron specimen with a dislocation density of 10^{10} cm/cm^3. Assume that the Burgers vector of iron is 0.248 nm. (5%)
   (c) If in a very slow tensile test a strain-rate of 10^{-7} s^{-1} is used, what dislocation velocity would be expected in the above iron specimen? (5%)

3. Given a small-angle tilt boundary whose angle of tilt is 0.2°, find the spacing between the dislocations in the boundary if the Burgers vector of the dislocations is 0.35 nm. (10%)

4. This diagram is for a hypothetical embryo of silver growing against an arbitrary mold wall. With the aid of this diagram:
   (a) Compute the angle of contact, θ, of the embryo with the mold wall. (5%)
   (b) Determine the magnitude of the factor that may be used to convert the homogeneous free energy needed to obtain a nucleus into that of the corresponding heterogeneous free energy. (5%)



5. Some martensitic transformations are completely reversible, however, there may be a large difference in the size of the hysteresis loop that couples a complete temperature induced cycle. Explain why, in some cases, the size of the hysteresis is large and in others it is small. The martensite transformation in steel is normally not reversible. Rationalize this fact. (10%)

6. Describe (a) the various reactions involved in the decomposition of martensite during tempering; (5%)
   (b) how the tempering phenomena change with carbon concentration in steel. (5%)

7. (a) What is the driving force for each of the three stages of annealing? (5%)
   (b) Why are grain boundaries favorable sites for nucleation or growth of precipitates? (5%)

8. The equilibrium copper-silver phase diagram is shown below.
   (a) A copper-silver alloy containing 60 weight percent silver is slowly cooled from 900 °C to just below the eutectic temperature. Draw the microstructure and estimate the weight percentages and compositions for each phase. (5%)
   (b) A eutectic composition is used for soldering applications. Why is this composition desirable? (5%)
   (c) According to the Hume-Rothery rules, what kind of phase diagram should be for the gold-silver alloy? The lattice constant of gold, silver, and copper is 4.0786 Å, 4.0863 Å and 3.6148 Å, respectively. (5%)
   (d) State Gibb's phase rule. What is the minimum and maximum number of phases which could exist in a pure metal? (5%)
   (e) What are the different types of solid solutions? (5%)