

※ 注意：請於試卷內之「非選擇題作答區」作答，並應註明作答之題號。

1. Please answer True or False for the following statements (30%)

- (1) Grain refinement leads to high strength, high ductility and high toughness.
- (2) Stored strain energy is the driving force for both recovery and recrystallization.
- (3) Annealing twin usually forms during recrystallization.
- (4) Grain growth undergoes at the expense of total grain boundary energy.
- (5) In ceramics, yield strength is more important than fracture strength.
- (6) 「小龍女於寒玉床上修練內功」 should be considered as creep for the ice bed.
- (7) In general, face-centered cubic crystalline materials have no ductile-to-brittle transition.
- (8) In binary solid state, the Gibbs degree of freedom of eutectoid point is zero, but that of eutectic point is one.
- (9) In the process of solidification, supercooling, in fact, is the driving force for transformation.
- (10) A higher temperature leads to higher electrical resistance for conductor and semi-conductor.
- (11) Direct bandgap usually shows higher electron mobility for indirect bandgap.
- (12) Crystallinity of linear polymer is usually better than branched chain polymer.
- (13) Cross-linked polymer usually exhibits a lower melting temperature, compared to linear polymer.
- (14) Under seven crystal family, there are thirteen types of Bravais lattice.
- (15) Equilibrium vacancy concentration is thermodynamically reversible.

2. Please explain the following terminology (10%):

- (1) Spillover effect;
- (2) CoWoS;

3. Ti is hexagonal (hcp) crystal. HCP-Ti (matrix) transforms into TiH_2 hydride (precipitate), Ti atoms will reconstruct into face-centered cubic (fcc) crystal, named fcc-Ti. Figure 1 shows the interface between fcc-Ti and hcp-Ti. The Orientation relationship between FCC-Ti and HCP-Ti: $\{10\bar{1}0\}_{hcp} \parallel \{110\}_{fcc}$ and $\langle 1\bar{2}10 \rangle_{hcp} \parallel \langle 1\bar{1}0 \rangle_{fcc}$. Please calculate the lattice mismatch and define what type interface it is. Lattice constants: hcp-Ti: $a = 0.2924 \text{ nm}$, $c = 0.4625 \text{ nm}$; fcc-Ti: $a = 0.4080 \text{ nm}$. (10%)

見背面

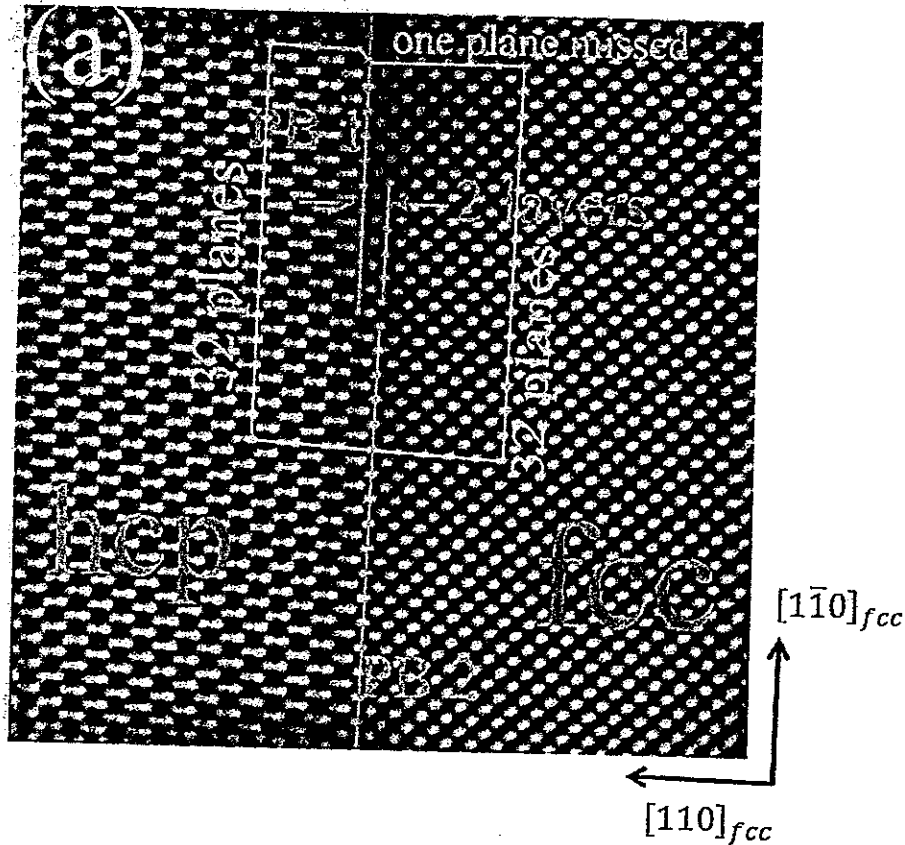


Figure 1 The interface between FCC-Ti and HCP-Ti.

4. Draw T and O interstitial sites for (1) face-centered cubic and (2) body-centered cubic crystal. (10%)
5. Draw the repeat units for the following polymers: (1) PVC; (2) PDMS; (3) PES. (10%)
6. What is the difference between the thermal conductivity of graphite and Al_2O_3 ? Which one is higher and why? (10%)
7. A silicon film is uniformly doped with 10^{18} cm^{-3} phosphorous atoms. What are electron and hole concentrations at 300 K. The intrinsic carrier concentration in silicon at 300 K is $1.0 \times 10^{10} \text{ cm}^{-3}$. (5%)
8. Write an essay in 120 words in English to summarize the importance of materials science & engineering in the Net-Zero era. (15%)