

Sample Exam for Practice

I. **Essay Questions.** Briefly answer the following questions:

1. Comment on the validity and consequences of the following statements:

(a) Increasing the yield stress of a metal decreases its fracture toughness and affects the way it can be processed to shape.

(b) A dislocation line bounds an area which has undergone slip. Dislocation lines must form closed loops or end on the surface.

2. In developing a self-assembly thin film structure, one needs to examine the bonding strengths of two metal surfaces (e.g. a quantum dot and a metal surface). Which metal, based on your knowledge and training, that zinc (Zn) or cadmium (Cd) metal surface will develop a strong bonding force with Sulfur (S) quantum dots? [Assume that all conditions are being equal between two metal surfaces.] Explain.

3. Which of the following substitutional solid solutions (Cu-30wt% Zinc or Cu-30wt% Nickel) would you select if higher tensile strength was the selection criterion?

4. What would you expect the effect of oxygen on the tensile strength of natural rubber? Explain.

II. Calculate and answer the following problems.

5. Determine the modulus of elasticity for tungsten and iron in the [111] and [100] directions. Which is elastically isotropy? Show your working steps.

Metal Type	C_{11}	C_{12}	C_{44}	S_{11}	S_{12}	S_{44}
Iron	23.70	14.10	11.60	0.80	-0.28	0.86
Tungsten	50.10	19.80	15.14	0.26	-0.07	0.66

6. Consider the following face-centered-cubic dislocation reaction:

$$\frac{a}{2}[110] \rightarrow \frac{a}{6}[21\bar{1}] + \frac{a}{6}[121]$$

- (a) Is the dislocation reaction energetically favorable?
- (b) What kind of dislocations are the $\frac{a}{6}\langle 121 \rangle$?
- (c) What kind of crystal imperfection results from this dislocation reaction?
- (d) What determines the distance of separation of the $\frac{a}{6}[21\bar{1}]$ and the $\frac{a}{6}[121]$?