材料科學導論
作業一
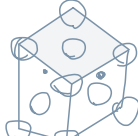
$$4 \times \frac{4}{3}\pi \cdot \left(\frac{\sqrt{2}}{4}a\right)^3$$

$$\frac{1}{8} \times 8 + 3 \times 2 \times \frac{1}{2} = 4$$

1. Aluminum (Al) is known to have face-centered cubic (FCC) structure. Please draw the FCC structure *(15 points)* and calculate the atomic packing factor (APF) for Al. *(25points)*.
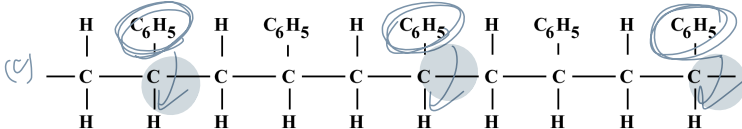
2. List and describe the difference between graphite and diamond *(30 points)*

石墨

排列方式不同: 石墨: 層狀　　顧石: 圓面體

·石墨 | sp² 軌域
導電性
空的電8軌域:
電8移動

3. Please sketch portions of a linear polystyrene molecule that are (a) syndiotactic, (b) atactic, and (c) isotactic. *(30 points)*
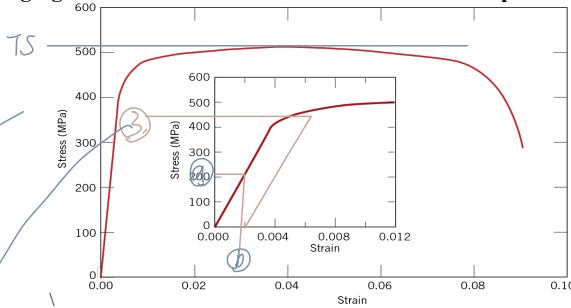
(C)

| | H | C$_6$H$_5$ | H | C$_6$H$_5$ | H | C$_6$H$_5$ | H | C$_6$H$_5$ | H | C$_6$H$_5$ |

—C—C—C—C—C—C—C—C—C—C—

| | H | H | H | H | H | H | H | H | H | H |

(a)　　(b)

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作業二

1. The following figure shows the tensile stress-strain curve for a plain-carbon steel.

Please draw on the figure for the location of (a),(b),(c) and give its definition

(a) What is its modulus of elasticity?   *(10 point)*

$$E = \frac{\Delta\sigma}{\Delta\varepsilon} = \frac{\sigma_2 - \sigma_1}{\varepsilon_2 - \varepsilon_1}$$

$$= \frac{a}{b}$$

(b) What is this alloy's tensile strength?   *(10 point)*

(c) What is the yield strength?   *(10 point)*

2. A cylindrical rod 380 mm long and having a diameter of 10.0 mm is to be subjected to a tensile load. If the rod is to experience neither plastic deformation nor an elongation of more than 0.9 mm when the applied load is 24,500 N, which of the four metals or alloys listed in the following table are possible candidates? *(10*

N/m^2

Material	Modulus of Elasticity (GPa)	Yield Strength (MPa)	Tensile Strength (MPa)
Aluminum alloy	70	255	420
Brass alloy	100	345	420
Copper	110	250	290
Steel alloy	207	450	550

$\dfrac{0.9}{10}$

$\dfrac{24500}{0.09}$

$= 272.22$

0.09

3. **Methylene chloride （二氯甲烷） is a common ingredient of paint removers. Besides being an irritant, it also may be absorbed through skin. When using this paint remover, protective gloves should be worn. The butyl rubber gloves found in the kitchen is usually 0.04 cm thick, can it be safely used as protective gloves?** *Note : The maximum allowable flux for a 150 lb person is less than 3.5 x 10-7 g/cm²/s . Compute the diffusion flux of methylene chloride through the gloves. and check the glove for paint removal use id safe or not. (25 points)*

Example: Chemical Protective Clothing (CPC)

Methylene chloride is a common ingredient of paint removers. Besides being an irritant, it also may be absorbed through skin. When using this paint remover, protective gloves should be worn.

If butyl rubber gloves (0.04 cm thick) are used, what is the diffusion flux of methylene chloride through the glove?

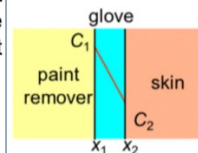Data:
– diffusion coefficient in butyl rubber:
  $D = 110 \times 10^{-8}$ cm²/s
– surface concentrations: $C_1 = 0.44$ g/cm³
  $C_2 = 0.02$ g/cm³

Example (cont).

• Solution – assuming linear conc. gradient

$$J = -D\frac{dC}{dx} \cong -D\frac{C_2 - C_1}{x_2 - x_1}$$

Data: $D = 110 \times 10^{-8}$ cm²/s
  $C_1 = 0.44$ g/cm³
  $C_2 = 0.02$ g/cm³
  $x_2 - x_1 = 0.04$ cm

$$J = -(110 \times 10^{-8} \text{ cm}^2/\text{s})\frac{(0.02\,\text{g/cm}^3 - 0.44\,\text{g/cm}^3)}{(0.04\,\text{cm})} = 1.16 \times 10^{-5} \frac{g}{\text{cm}^2\text{s}}$$

4. Briefly describe the definition of these terms.

   (a) Edge dislocation *(10%)* 移動//剪

  – extra half-plane of atoms inserted in a crystal structure
  – b perpendicular (⊥) to dislocation line

  (b) Interstitial Diffusion *(10%)*

  spiral planar ramp resulting from shear deformation
  – b parallel (∥) to dislocation line

  (c) Poisson's ratio *(15%)*

$$v = -\frac{\varepsilon_x}{\varepsilon_z}$$

    x axial 和 Z axial的 應變比值

定義為材料受拉伸或壓縮力時，材料會發生變形，而其橫向應變與縱
向應變的比值，是一無因次量的物理量。X,之形變的比值,為一個無因次的物理量
當材料在一個方向被壓縮，它會在與該方向垂直的另外兩個方向伸
長，這就是蒲松現象，蒲松比是用來反映蒲松現象的無因次量的物理
量。