KLE Technological University
Creating Value Leveraging Knowledge

Department of Chemistry

In Semester Assessment (ISA) - II (P, Q & R Divisions)		
Course: Engineering Chemistry		**Course Code: 15ECHB102**
Duration: 75 Minutes.	**Date: 25-07-2022 Time: 10:00 AM to 11.15 AM**	**Max. Marks:40**
Scheme and solution		

Q1 (a) **Manufacture of EGS by CVD process** – Diagram and Explanation ……. 3 M

(i) Reduction: **$2\ HSiCl_{3(g)} + 2\ H_2\ (g) \rightarrow 2Si(s) + 6\ HCl(g)$** at 1400°C …….. 2 M

(ii) Pyrolysis: **$SiH_4 \rightarrow Si + 2H_2(g)$** at 900°C …….. 2 M

(b) **Electroplating of gold by acid cyanide bath**: Explanation and bath composition: Potassium gold cyanide: 6.0-18.0g/dm^3; Potassium citrate: 50.0g/dm^3; Mono potassium dihydrogen phosphate: 20.0g/dm^3; pH: 3–6; Temp.: 40-70°C; Current density: 1-20A/ft^2; Cathode efficiency: 80-90%; Leveler: Sodium allyl sulphonate; Anode: Pt, Platinized Ti; Cathode: Object to be electroplated (free from dirt. Oil and grease, etc.). 4 M

Applications: Printed circuits, transistors, integrated circuit parts, instrument coverings and external surfaces exposed to radiation in space are gold plated; For decorative purposes in jewelry, watch cases, pen points, hallow ware, etc., 3 M

(c) **(i) Concentration of 'P' atoms in the melt, C_l:**

- **Segregation constant, $K_o = C_s / C_l$**

  $C_l = C_s / K_o = 3X10^{15} / 0.32 =$ **$9.375X10^{15}$** atoms/cm^3 …… 2 M

(ii) Weight of "P" atoms to be added for $25X10^3$ g of Si, W_P :

- **Volume of Silicon, V_{si}:**

  V_{Si} = Weight of Si / Density of Si = $25X10^3 / 2.33 =$ **$10.7296X10^3$** cm^3 …… 1M

- **Total number of 'P' atoms in the given volume of Si, T_P :**

  $T_P = C_l \times V_{si} = 9.375X10^{15} \times 10.7296X10^3 =$ **$100.59X10^{18}$** atoms ……... 1 M

- **Weight of 'P' atoms to be added, W_P :**

  $W_B = \frac{\text{Atomic weight of 'P' X Total number of 'P' atoms}}{\text{Avogadro Number}}$ grams

  $W_P = (30.97 \times 100.59 \times 10^{18}) / 6.023 \times 10^{23}$ grams

  $W_P =$ **517.23×10^{-5} g**. $= 517.23 \times 10^{-5} \times 1000$ mg

❖ **$W_P = 5.1723$ mg**. …….. 2 M

Q2 (a) Thermal Oxidation: Diagram and Explanation 3 M

Dry oxidation and Wet Oxidation - Reactions. 4 M

(b) The electro optic effect of liquid crystals controls brightness/darkness of the light emerging from its elements and this property of liquid crystals are used in information displays. Numerical display has 7 segments, whereas alphabets are displayed using 14 segments. 1M

7 segment LCD for a digit. Consider a typical LCD cell and the electrical circuit with 4 rows and 2 columns for a digit to appear. Each row is connected to two segments and each column is connected to 3 or 4 segments and **a, b, c, d, e, f** and **g** are LCD cells. 3M

a: R1C1; **b:** R1C2; **c:** R2C2; **d:** R2C1; **e:** R3C1; **f:** R3C2; **g:** R4C2

Display of number 1 (c f); 7 (a c f); 6 (a b d e f g) and explanation 3M

(c) Throwing Power: Ability of the bath to produce uniform and even deposit on the entire surface of the substrate. …… 2M

X = d1/d2 = d1/4.8**; d1 = 4.8 * X; Y =** W2/W1 = 68/64 = **1.0625** 2M

% of TP = ((X-Y)/(X+Y-2)) * 100 = 75%

d1 = 6.9 cm 2M

Q3 (a) **Czochralski crystal pulling technique**: Single crystalline electronic grade Si is used as a seed to grow single crystal Si from polycrystalline Si. When the Si melt is pulled out, the atoms of polycrystalline Si solidifies and reproduces the same orientation and crystal structure as that of the single crystalline electronic grade silicon seed. 1M

The **puller rate** is maintained at around **50-100 mm/hour** with **rotation** of **100 rpm** at a **pressure** of **2-50 atmospheres.** 1M

Diagram, explanation of process, segregation constant 3M + 2M

(b) **Liquid crystals** - Meaning 1M

Thermotropic liquid crystals: The class of compounds that exhibit liquid crystal behaviour on variation of temperature alone. Example: **Cholesteryl benzoate** is said to exist as liquid crystal between145.5^{0}C and 178.5^{0}C. …… 3M

Lyotropic liquid crystals: Obtained by mixing the two components and increasing the concentration of one of the components till liquid crystal phase in observed.
Example: Soap molecules (Soap - water mixture).
Micelles: Diagram and Formation of micelle - explanation. …… 3M

(c) **Derivation** : $\frac{\text{Thickness of Silicon consumed}}{\text{Thickness of } SiO_2 \text{ grown}} = \frac{(28.09/2.33)}{(60.08/2.20)} = \frac{12.056}{27.31} = 0.44$ 3M

Thickness of SiO_2 grown $= \frac{\text{Thickness of Silicon consumed}}{0.44} = \frac{88}{0.44} = 200$ Å …….. 2M

Increase in thickness of Si wafer = Thickness of SiO_2 grown - Thickness of Si consumed = 200 – 88 = **112 Å** 1M

Dr. S. Dhanalakshmi
Course coordinator,
Chemistry Department.