Module 2, Lecture 10: Vapour-Liquid-solid method

Problem:

1. In VLS technique, the catalyst occurs as _____ on the substrate. (liquid droplet)

2. The growing material precipitates at _____. (Interface between the substrate and liquid).

3. Which type of growth is achieved by VLS technique? (1D growth)

4. What should be the distribution coefficient of the catalyst at the decomposition temperature? (less that 1)

5. How can one control the diameter of the droplet and thereby control the diameter of the nanowire? (by maintaining small equilibrium vapour pressure of the catalyst over liquid droplet).

6. How is the diameter of the nanowire influenced by wetting characteristic of the catalyst? (small wetting angle results in large diameter)

7. What is Kelvin equation? ($\ln(p/po) = (-2\gamma\Omega)/(kTr)$)

8. What does Kelvin equation signify? (It shows dependence of equilibrium vapour pressure or solubility on surface energy and radius of the surface)

9. Supersaturation of the material with catalyst should be kept low. Why? (for growth of uniform and high quality nanowire)

10. What will happen if supersaturation is further increased? (leads to termination of growth)

11. At what temperature on should carry out the synthesis of nanowires? (above the eutectic temperature of the catalyst and reactant)

12. Which type of materials is used as catalyst? (inert)

13. State the factors on which the morphology of ZnO (shown in the lecture) depends. (source, substrate temperature, air flow rate, coating thickness)

14. What type of morphology for ZnO was achieved in the high T zone? (nanowires)

15. In which temperature zone, nanorods of ZnO formed? (low T zone)

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Solution:

1. liquid droplet

2. Interface between the substrate and liquid

3. 1D growth

4. less that 1

5. by maintaining small equilibrium vapour pressure of the catalyst over liquid droplet

6. small wetting angle results in large diameter

7. $\ln(p/po) = (-2\gamma\Omega)/(kTr)$

8. It shows dependence of equilibrium vapour pressure or solubility on surface energy and radius of the surface

9. for growth of uniform and high quality nanowire

10. leads to termination of growth

11. above the eutectic temperature of the catalyst and reactant

12. inert

13. source, substrate temperature, air flow rate, coating thickness

14. nanowires

15. low T zone