

*To be Marked*

MAJOR TEST  
Dated 1<sup>st</sup> May 2008

**PHL 702 Science & Technology of Thin Films**

**Answer all questions**

**Time Two Hours**

**Maximum Marks 40**

1. Define Epitaxy. What should be the typical deposition parameters to obtain an epitaxial film of (1) Au on single crystal (X-tal) substrate of NaCl, (2) Si film on Si X-tal Si and (3) Au on X-tal Si. What are the mechanisms of growth in these deposition processes? Do you visualize any problem in these deposition processes? (6)
2. Draw representative Paschen's curves for a glow discharge system. Explain the nature of these curves. What are typical values of voltages needed to achieve breakdown of gases ( $N_2$ ,  $O_2$ , Ar) at atmospheric pressure for a given parallel plate system with a separation of about 5 cms. What happens if the pressure is reduced continuously up to  $10^{-5}$  torr? (6)
3. Draw I-V characteristics of a glow discharge. Explain why abnormal discharge is used in a sputtering process? What are the advantages and disadvantages of magnetron sputtering in balanced and unbalanced mode? (6)
4. What are the geometrical conditions for RF sputtering in a diode configuration and in a plasma etching configuration? How do these processes work? (5)
5. Draw a simple CVD reactor and explain the role of boundary layer in the CVD deposition process. How do the temperature, pressure, flow of gas affect the boundary layer formation? Write typical reaction for deposition of  $Si_3N_4$ ,  $SiO_2$ , ZrC, BN thin films. (6)
6. Write down an expression for critical radius and for nucleation barrier in case of a hemispherical nucleation on a given substrate. On what parameters does the nucleation rate depend upon? How do these parameters depend upon the bulk values of the associated processes? (6)
7. How does the micro-structure of a film depend upon the temperature of deposition? Describe the structure- zone model for (1) an evaporated thin film and for (2) a sputtered thin film. (5)

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