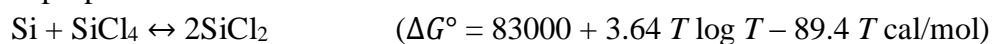


Assignment – 7
Fundamentals of Materials Processes

1. For molecular flow, Knudsen number (K_n) is
 - a. $K_n = 0$
 - b. $K_n > 1$**
 - c. $1 > K_n > 0.001$
 - d. $K_n < 0.001$
2. Following steps in the CVD growth are dependent on the flow conditions
 - a. Adsorption and diffusion of species on surface
 - b. Surface reaction leading to film growth
 - c. Desorption of volatile by-products away from the reaction zone**
 - d. None of the above
3. Gas flow inside an APCVD reactor is
 - a. Molecular
 - b. Viscous**
 - c. Turbulent
 - d. None of the above
4. In a horizontal CVD reactor, thin film thickness (d) changes with axial distance (x) from gas inlet as
 - a. $d \propto 1/x$
 - b. $d \propto 1/x^2$
 - c. $d \propto e^{-x}$**
 - d. $d \propto x$
5. Low Pressure CVD (LPCVD) is better compared to atmospheric pressure CVD (APCVD) because,
 - a. Better step coverage
 - b. Better film thickness uniformity
 - c. Higher deposition rates
 - d. All of the above**
6. Gas phase diffusivity (D) of gaseous species across boundary layer is related to gas pressure (P) as
 - a. $D \propto P$
 - b. $D \propto 1/P$**
 - c. $D \propto e^{-P}$
 - d. $D \propto P^{1.5}$

- Questions 7 to 9 are based on following:

The disproportionation reaction



is carried out in a closed tubular atmospheric pressure reactor whose diameter is 15 cm. Deposition of Si occurs on a substrate maintained at 650 °C and located 25 cm away from the source, which is heated to 800 °C. Assume, thermodynamic equilibrium

prevails at source and substrate and viscosity of the gas in chamber is 0.08 cP (1 cP = 9.87×10^{-6} atm-sec, $R = 1.987$ cal/mol-K = 82.05 cm³-atm/mol-K).

7. What is the partial pressure of SiCl₂ at the source?
 - a. 1 atm.
 - b. 0.4 atm.**
 - c. 0.5 atm.
 - d. 0.04 atm.
8. What is the partial pressure of SiCl₂ at the substrate?
 - a. 0.6 atm.
 - b. 0.5 atm.
 - c. 0.05 atm.**
 - d. 0.03 atm.
9. What is the flux of SiCl₂ at substrate transported from source to substrate by bulk flow?
 - a. 1×10^4 moles/cm²-sec
 - b. 9.1 moles/cm²-sec
 - c. 9.1×10^2 moles/cm²-sec
 - d. 9.1×10^{-2} moles/cm²-sec**
10. In lattice mismatched epitaxial layer, beyond critical thickness, strain is relieved by
 - a. Formation of voids
 - b. Formation of misfit dislocations**
 - c. Intermixing of substrate and thin film material
 - d. Misfit strain is present and film is under stress