

Assignment – 5
Fundamentals of Materials Processes

1. Maxwell-Boltzmann distribution defines
 - a. velocity of a gas atom/molecule
 - b. distribution of velocities of atoms/molecules in gas**
 - c. temperature of gas
 - d. number of gas atoms/molecules in a given volume
2. Mean free path (λ_{mfp}) of gas atoms/molecules is related to gas pressure (P) as
 - a. $\propto \exp(-P)$
 - b. $\propto P^2$
 - c. $\propto P^{-1}$**
 - d. $\propto P$
3. Which of the following vacuum pump(s) should be used for a deposition chamber where you want to deposit highly pure thin film of semiconducting material?
 - a. Rotary pump
 - b. Roots pump
 - c. Diffusion pump backed by rotary pump
 - d. Turbo-molecular pump backed by rotary/roots pump**
4. Which pressure gauge should you choose for measuring pressure in the range of 10^{-7} to 10^{-10} torrs?
 - a. Thermocouple gauge
 - b. Pirani gauge
 - c. Baratron gauge
 - d. Penning gauge**
 - **Questions 5 and 6 are based on this:** After pumping down (creating vacuum) in a thin film deposition chamber with volume 30 liters to a base pressure of 1×10^{-6} torrs, the vacuum pumps are isolated. The pressure inside the chamber rises to 1×10^{-5} torrs in 15 minutes.
5. What is the leakage rate in vacuum system?
 - a. 5.0×10^{-7} torr-liters/sec
 - b. 3.0×10^{-7} torr-litres/sec**
 - c. 1.5×10^{-7} torr-litres/sec
 - d. 1.5×10^{-8} torr-litres/sec
6. If a vacuum pump with effective pumping speed of 40 litres/sec is attached to the vacuum chamber, what is the ultimate pressure that can be reached?
 - a. 7.5×10^{-9} torrs**
 - b. 5.0×10^{-9} torrs
 - c. 5.0×10^{-8} torrs
 - d. 7.5×10^{-10} torrs
7. How long would it take to deposit 200 Å thick gold film over a 5 cm^2 area using a 2 cm^2 source at 1500 K placed in planetary configuration in a deposition chamber of radius 20 cm? (atomic weight of gold = 197, density = 19.3 gm/cm^3 and vapor pressure of gold @ 1500 K = 5.0×10^{-3} torr.)
 - a. 10 minutes
 - b. 1 hour
 - c. 2.5 hours**
 - d. ~ 1 day

8. What is the wavelength range of laser for PLD using non-metallic targets?
 - a. **Ultraviolet (200 nm – 400 nm)**
 - b. Visible (400 nm – 700 nm)
 - c. Infrared (700 nm – 1 mm)
 - d. Microwave (1 mm – 1 meter)
9. For a uniform thin film deposition over large number of substrates you should use
 - a. point source
 - b. surface source
 - c. highly directional source
 - d. **keep substrates and source in planetary arrangement**
10. In electron-beam thin film deposition technique, the electron beam is scanned on the surface of material to be evaporated by
 - a. moving source crucible with respect to electron-beam
 - b. using electric field to deflect electron-beam
 - c. **using magnetic field to deflect electron-beam**
 - d. using piezoelectric crystal for small vibrations