1. For CVD deposition of a film, it is found that the mass transfer coefficient $h_G = 10.0 \text{ cm/s}$ and the surface reaction rate coefficient $k_S = 1 \times 10^7 \exp(-1.9 \text{ eV/kT}) \text{ cm/s}$. For a deposition at 900°C, which CVD system would you recommend using: (a) a cold-walled, graphite susceptor type; or (b) a hot-walled, stacked wafer type? Explain your answer.

At 900°C, $k_s = 1 \times 10^7 \exp\left(\frac{-1.9eV}{kT}\right) \text{ cm/s} = 1 \times 10^7 \exp\left(\frac{-1.9eV}{8.62 \times 10^{-5} eV/K \times 173K}\right) = 0.069 \text{ cm/s}$

This is much less than $h_G$ (10.0 cm/s), so that $k_S << h_G$. This means that the system will be in the reaction controlled regime. Thus you should recommend using (b) a hot-walled, stacked wafer type system since in the reaction-limited regime we are very sensitive to temperature variations but not too sensitive to gas flow variations.

2. Plot the deposition rate (on a log scale) versus $1/T$ (Kelvin), for 600-1100°C, for an atmospheric CVD system with the following parameter values:

- $h_G = 0.5 \text{ cm sec}^{-1}$ (assumed independent of temperature)
- $k_S = 4 \times 10^6 \exp(-1.45 \text{ eV/kT}) \text{ cm/s}$
- Partial pressure of incorporating species = 1 torr
- $N = 6.2 \times 10^{22} \text{ cm}^{-3}$

Identify the reaction and mass transfer limited regimes.
The reaction-limited regime is roughly below 750 °C. The diffusion limited regime is roughly above 900 °C.

3. Repeat problem 2 when the total pressure is decreased to 1 torr, so that $h_G$ increases by 100 times. Assume that the partial pressure of the incorporating species remains the same.
No solution provided for this one. You are on your own!

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