

Name: _____

Homework for Lecture 10, 11, 12

A liquid metal (α phase) is contained in a container (δ phase). Assume the melting point of the metal is $T_m = 1350$ K, the molar entropy change of melting is $\Delta S_M = S_L^0 - S_S^0 = 5.5 \text{ J mol}^{-1} \text{ K}^{-1}$, and the molar volume (for both the liquid and solid phase) is $V_M = 9.6 \times 10^{-6} \text{ m}^3/\text{mol}$. Now, we super-cool the liquid metal to $T = 1000$ K,

- 1). What is the critical radius of homogeneous nucleation for solidification, if the interface energy between liquid (α) and solid (β) phase, $\gamma_{\alpha\beta} = 0.15 \text{ J/m}^2$?
- 2). If the interfacial energy between the liquid and the container is $\gamma_{\alpha\delta} = 0.10 \text{ J/m}^2$ and that between the metal solid and the container is $\gamma_{\beta\delta} = 0.175 \text{ J/m}^2$, what is the contact angle of the heterogeneous nucleus on the container wall?
- 3). What is the volume of the critical heterogeneous nucleus on the container wall? Draw a schematic diagram of the nucleus on the container wall.