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### Homework for Lecture 10, 11, 12

A liquid metal ( $\alpha$  phase) is contained in a container ( $\delta$  phase). Assume the melting point of the metal is  $T_m = 1500$  K, the molar heat of melting is  $\Delta H_M = H_L^0 - H_S^0 = 16000$  J/mol, and the molar volume (for both the liquid and solid phase) is  $V_M = 10^{-5}$  m<sup>3</sup>/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 ( $\alpha$ ) and solid ( $\beta$ ) phase,  $\gamma_{\alpha\beta} = 0.1$  J/m<sup>2</sup>?
- 2). If the interfacial energy between the liquid and the container is  $\gamma_{\alpha\delta} = 0.15$  J/m<sup>2</sup> and that between the metal solid and the container is  $\gamma_{\beta\delta} = 0.1$  J/m<sup>2</sup>, 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.

**Answer:** covered in Lecture 10, 11, 12