

Tutorial problems and questions

1. Using typical values, show that the capillary effects are very important for particle in the range 1-100 nm.

Answer

As seen in Part III of this course notes, assuming the α phase to be a regular solution and the β phase to be nearly pure B , one can obtain the composition of the α phase in equilibrium with the β phase of radius r as

$$X_r = X_\infty \left(1 + \frac{2\gamma V_m}{rRT} \right) \quad (4)$$

Consider the typical values of 200 mJ/m² for γ , and 10⁻⁵ m³ for V_m ; at 500 K (since $R = 8.31$ J/mol/K), one obtains

$$\frac{X_r}{X_\infty} = 1 + \frac{1}{r(\text{in nm})} \quad (5)$$

Thus, for radii in the nanometre range, there will be considerable changes in equilibrium compositions which become negligible when the length scales are in the micron range