MSE 360: Phase Transformation and Diffusion

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Lecture 7
Diffusion in Substitutional Alloys

\[ \frac{\Delta C}{\Delta t} = \frac{\partial}{\partial x} \left( \tilde{D} \frac{\partial C}{\partial x} \right) \]

\[ \tilde{D} = X_B D_A + X_A D_B \] Darken’s equation

\[ \tilde{D} = \tilde{D}_0 e^{\frac{Q}{RT}} \]

\[ D_A = D_{A0} e^{\frac{Q_A}{RT}} \]

\[ D_B = D_{B0} e^{\frac{Q_B}{RT}} \]

\( \tilde{D} \) is roughly constant at \( T_m \)

bcc lattice has higher diffusion than fcc

For dilute solution:
Solutions to the Fick’s second Law

\[ J_A = -D_A \frac{\partial C_A}{\partial x} \]
\[ J_B = -D_B \frac{\partial C_B}{\partial x} \]
\[ J_A = -(J_B + J_V), \]

C_{0} = C_A + C_B

Kirkendall Effect:

\[ J_A \]
\[ J_B \]
\[ J_V \]

Cu-Zn Alloy
Factors affecting Diffusion direction

1. Strain field: Diffusion to GB and dislocations
   Implications:

2. Electric field
Diffusion along Grain Boundaries

Temperature effect on Diffusion mechanism
Transition T=0.75-0.8 Tm
Home Work

• Reading assignment: Ch. 2.7.2, 2.8
• HW: none,