MSE 360: Phase Transformation and Diffusion

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Lecture 5
The mean vibrational energy = 3 kT

Quiz: Octahedral sites in fcc; tetrahedral sites in fcc; octahedral sites in bcc, Fig. 2.3
Interstitial Diffusion

Fick’s First Law: \( J = -D \frac{dC}{dx} \)  
Steady state diffusion

\[ J_1 = \frac{1}{6} \Gamma n_1 \]
\[ J_2 = \frac{1}{6} \Gamma n_2 \]
\[ J = J_1 - J_2 = \frac{1}{6} \Gamma (n_1 - n_2) \]
\[ J = -D \left( \frac{1}{6} \Gamma \alpha^2 \right) \frac{dC}{dx} \]
\[ J = -D \frac{dC}{dx} \]  
Fick’s first law of diffusion

C_1 = n_1/\alpha, c_2 = n_2/\alpha

n_1-n_2=\alpha(c_1-c_2)
=\alpha^2 (c_1-c_2)/\alpha
=-\alpha^2 \frac{dc}{dx}

Unit of J: quantity/m^2/s

\( \Gamma \) is the frequency of jumps

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Q=$\Delta H$,  G=H-TS,  Rate controlled process, definition of Q,
Z = # of sites for jump
V = vibrational frequency

\[ D_0 = \frac{1}{6} \alpha^2 z v \exp\left(\frac{\Delta S}{R}\right) \]
Described by Fick’s first law
\[ \frac{dC}{dx} = \frac{(0-C_H)}{t}, \text{ t is thickness} \]
Home Work

- Reading assignment: Ch. 2.2.4 to 2.3.3
- HW: