신소재공학과 20202120 최창민

1)

CSL(Coincidence site lattice) Boundary란,
두 Grain의 lattice가 서로 인접하게 접촉하여
Grain Boundary를 형성하는 경우를 말한다.
CSL Grain boundary의 경우, 같은 값을 이루어
Misfit이 높은 Grain boundary를 형성하는
경우와 다르게 값이 낮다.

$$\Sigma = \frac{\text{Volume of CSL unit cell}}{\text{Volume of standard crystal unit cell}}$$

일 때,

$\Sigma 1$ = low angle grain boundary

$\Sigma 3$ = coherent twist boundary

(2)

$$\frac{X_i^{\phi}}{X_n^{\phi}} = \frac{X_i^{\beta}}{X_n^{\phi}} e^{-\frac{\Delta G_i^{sg}}{RT}} \quad \therefore X_i^{\phi} = \frac{X_i^{\beta} e^{-\frac{\Delta G_i^{sg}}{RT}}}{\frac{X_n^{\beta}}{X_n^{\phi}}}$$

$$\frac{X_n^{\beta}}{X_n^{\phi}} = X_n^{\beta}\left(1 + \frac{1 - X_n^{\phi}}{X_n^{\phi}}\right) = X_n^{\beta}\left(1 + \frac{\sum_{i=1}^{n-1} X_i^{\phi}}{X_n^{\phi}}\right)$$

$$X_n^{\beta}\left(1 + \frac{\sum_{i=1}^{n-1} X_i^{\phi}}{X_n^{\phi}}\right) = X_n^{\beta} + \frac{\sum_{i=1}^{n-1} X_i^{\beta} X_n^{\beta}}{X_n^{\phi}} = X_n^{\beta} + \frac{\sum_{j=1}^{n-1} X_j^{\beta} X_n^{\phi} e^{-\frac{\Delta G_i^{sg}}{RT}}}{X_n^{\phi}}$$

$$X_n^{\beta} + \frac{\sum_{j=1}^{n-1} X_j^{\beta} X_n^{\phi} e^{-\frac{\Delta G_i^{sg}}{RT}}}{X_n^{\phi}} = X_n^{\beta} + \sum_{j=1}^{n-1} X_j^{\beta} e^{-\frac{\Delta G_i^{sg}}{RT}}$$

$$= \left(-\sum_{j=1}^{n-1} X_j^{\beta} + \sum_{j=1}^{n-1} X_j^{\beta} e^{-\frac{\Delta G_i^{sg}}{RT}}\right)$$

$$= 1 + \sum_{j=1}^{n-1} X_j^{\beta}\left(e^{-\frac{\Delta G_i^{sg}}{RT}} - 1\right)$$

$$\therefore \frac{X_n^{\beta}}{X_n^{\phi}} = 1 + \sum_{j=1}^{n-1} X_j^{\beta}\left(e^{-\frac{\Delta G_i^{sg}}{RT}} - 1\right)$$

$$\therefore X_i^{\phi} = \frac{X_i^{\beta} e^{-\frac{\Delta G_i^{sg}}{RT}}}{\frac{X_n^{\beta}}{X_n^{\phi}}} = \frac{X_i^{\beta} e^{-\frac{\Delta G_i^{sg}}{RT}}}{1 + \sum_{j=1}^{n-1} X_j^{\beta}\left(e^{-\frac{\Delta G_i^{sg}}{RT}} - 1\right)}$$