Dislocations at Semi-Coherent interfaces

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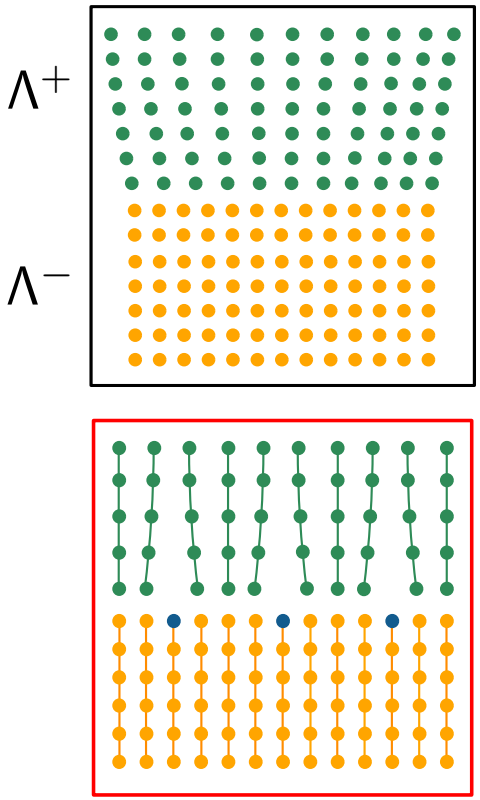

- Polycrystal with two different underlying lattice structures $\Lambda^+ = \alpha\Lambda^-$ $(\alpha > 1)$
- Semi-coherent interface corresponds to small misfit $\alpha \approx 1$
- Elastic Energy scales like R^3 while Dislocation Energy like R^2
- For large interfaces nucleation of dislocations is energetically preferred and a Periodic Network of Edge Dislocations is observed at the interface

Variational Models

Semi-discrete Model

- We consider an energy $\int_{\Omega_R^+} W(F(x))\,dx$ with $W\colon \mathbb{M}^{3\times 3} \to [0,+\infty]$
- Ω_R^+ overlayer (equilibrium αI) and Ω_R^- underlayer (assumed rigid)
- Strain is $F \in L^p$ with $1 < p < 2$ and

$$\operatorname{curl} F = -\mathbf{b}_\gamma \otimes \dot{\gamma}\, d\mathcal{H}^1 \llcorner \gamma$$

  with γ dislocation line on interface and $\mathbf{b}_\gamma$ relative Burgers vector
- Minimal dislocation energy is s.t. $E_{\alpha,R} \sim R^2$ as $R \to \infty$ (dislocations are energetically preferred) on a Periodic Network of Edge Dislocations

Simplified Continuum Model

- Total Energy consists of an Elastic term plus a Surface term taking into account the total dislocation length
- As $R \to \infty$ dislocations are energetically preferred
- Perform Taylor expansion as $R \to \infty$ of Total Energy (by Γ-convergence)