A Level Set Finite Element Anisotropic Grain Growth Study
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The velocity of the grain boundary can be achieved by the grain boundary. At equilibrium, neglecting the torque terms, the position of the grain boundary $n$ at time $t$ is defined as:

$$n = \mu P_n$$

(2)

where $\mu$ is the mobility of the grain boundary and $P_n$ is the unit normal to the boundary.

**Conclusions**

- The equilibrium angles at the triple junction can not be obtained naturally without considering torque terms.
- The kinetics of the triple junction and its surroundings are completely dependent upon the equilibrium angles.

**Bibliography**


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**Anisotropic Adaptation**

Extension of the $\gamma$ field to the entire $\Omega$ domain:

$$\gamma(X, \Omega) = \gamma(X, \Gamma) \quad \forall X \in \Gamma, \Delta \gamma = 0 \quad \forall X \in \Omega$$

(5)

using a FE solver.

A supplemental convolution term due to the weak formulation is taken into account in the anisotropic model using a Convection-Diffusion assembly of the FE matrix: Equation (4) becomes:

$$\frac{\partial \phi}{\partial t} + \nabla \cdot (\kappa \nabla \phi) = 0$$

(6)

with a weak formulation using $\phi \in H^1(\Omega)$ as a test function:

$$\int_\Omega \frac{\partial \phi}{\partial t} V + \int_\Omega \kappa \nabla \phi \cdot \nabla V = 0$$

(7)

**Equilibrium Angles**

- As $\sigma$ increases, the solutions are closer and closer together.
- The angles for $\sigma = 1$ are clearly much lower than predicted by the theory.
- Equation (9) Young’s equilibrium is not respected.
- Although convergence of the method is ensured, the simulation does not arrive at the correct solution.
- The question must be revisited in the state of the art.

**Velocities**

- Relative velocities of the triple junction get lower as $\sigma$ increases.
- A stationary state is obtained ($v_3 = 0$) at $t = 0.14$.
- Kinetics are around twice as fast as they should be for $\sigma = 2$.
- Obtained velocities at the triple junction are much higher than those predicted using the isotropic grain boundary energies for every $\sigma$.
- Kinetics of the triple junction are coherent with obtained angles.
- Kinetics of the profile completely depend on the equilibrium angle.