

Diffusion-Induced Grain Boundary motion : a system with three free boundaries

Oliver Penrose

DIGM occurs when a thin polycrystalline specimen made of one metal (the solvent) is put in the vapour of another metal (the solute). The solute diffuses into the specimen along grain boundaries and sets up elastic stresses which cause the grain boundary to move. The shape of the moving grain boundary is determined by a differential equation which balances this elastic force against the forces due to the curvature of the boundary and the resistance to its motion. Meanwhile, the shapes of the surfaces of the two grains also satisfy differential equations, because solvent atoms diffuse along the surface and their chemical potential depends on its curvature. The DE's for the grain boundary and the two grain surfaces are coupled by conditions at the triple junction where they meet. I will show some cases where the resulting mathematical problem can be solved to determine such things as the speed of a steadily moving grain boundary.