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Pore drag and drop: volume diffusion control

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The coupled motion of a grain boundary and an attached fluid filled pore is considered. The essential physical processes addressed are pore drag and pore drop. The behavior of the grain boundary is determined by the surface tension effect, i.e., the boundary moves to reduce its curvature and surface area. Movement of the pore requires mass transfer, which in this model occurs by volume diffusion of the matrix atoms through the pore fluid. The matrix atoms leave the leading pore surface, diffuse through the fluid and crystalize on the other pore surface. The kinetics of dissolution at the leading surface and of precipitation at the trailing surface is considered to be fast relative to diffusion. In this case the effective pore motion is controlled by mass transfer through the fluid filled pore. Mathematical treatment of the pore motion requires solution of the diffusion equation for the concentration of the matrix atoms in the pore volume. The calculation must also account for the motion, that is, we have to solve a problem with moving boundaries. We quantify the mobility of the pore and determine the critical velocity at which the pore separates from the moving grain boundary.