A grain boundary migration driving force derived from grain boundary energy anisotropy

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Abstract

Recent studies of polycrystalline Ni, SrTiO3, and Fe have shown no correlation between curvature and migration velocity, contradicting the observed migration behavior of individual grain boundaries in bicrystals. In this paper, we present evidence for the existence of a driving force for grain boundary migration that is independent of the curvature driving force. This new driving force arises from grain boundary energy anisotropy and, more specifically, the anisotropy associated with the grain boundary plane inclination. We find the grain boundaries migrate in such a way as to replace higher energy grain boundaries with relatively lower energy boundaries. Experimental evidence, derived from the time evolution of three-dimensional polycrystalline microstructures, indicates that the area expansion of a given grain boundary is linearly correlated to the difference in the energies of the grain boundaries that meet at a triple line. This confirms the idea that grain boundaries migrate in such a way as to replace higher energy grain boundaries with lower energy grain boundaries. The total driving force for grain boundary migration in polycrystals is a combination of the curvature driving force and the driving force that derives from grain boundary energy anisotropy. It is this latter component that disrupts the expected curvature-velocity correlation.

Keywords: Grain Boundary, Microstructure, Recrystallization and grain growth

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