New Perspectives on Grain Boundary Migration in Polycrystals

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Using high-energy diffraction microscopy, we have measured the velocities of grain boundaries within a Ni polycrystal evolving by normal grain growth under a capillary driving force. Thousands of grain boundaries were tracked and their velocities and curvatures were classified by their crystallographic characteristics. Among the findings, two are noteworthy and will be discussed in this seminar. First, the velocities vary with all five crystallographic grain boundary parameters. Because boundaries are curved, and a single misorientation has a range of boundary plane orientations, one might expect the migration of grain boundaries with a particular misorientation to be independent of grain boundary plane orientation. However, on average, some orientations are faster than others and for a single misorientation, velocities can vary by a factor of three or more. Second, grain boundary velocity is independent of grain boundary mean curvature. Because curvature is an important component of the driving force, velocity and curvature are expected to be correlated positively. However, the evidence for such a correlation is poor. In the remainder of the seminar, I will briefly present three possible explanations for these observations that can be discussed as a group: constrained migration of boundaries in connected networks, defect (disconnection) mediated grain boundary migration, and the influence of grain boundary stiffness on migration.