Interplay between grain growth, grain boundary migration rates and interface chemistry

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Our existing theories on grain boundary migration rates have their origin based on the observations made in metallic systems. For the longest time they were self consistent within the metallic systems and few contradicting observations were regarded as anomalies. One of the pillars of these theories is the so-called solute-drag on the migrating grain boundary. According to this model the clean boundaries are the fastest to move and the impurity atoms would cause a drag (a slowing down) on the migration rates.
However, more and more experimental evidence is accumulating indicating that this simple-minded approach is failing for ceramic boundaries. Our studies in the past eight years indicated that impurity doped aluminum oxide exhibit accelerated grain growth at critical impurity concentrations. Electron microscopy analysis of the fast moving and "dirty" boundaries hinted towards a possible structural transformation in the core of the boundary. A critical discussion of this phase transformation in the core of the boundary will be presented and related to the grain boundary migration rates in impurity doped ceramics.