MM 10: Topical Talk: M. Salvalaglio

Time: Tuesday 9:30–10:00 Location: H10

Topical Talk MM 10.1 Tue 9:30 H10

Understanding the impact of disconnection flow on microstructure evolution — •Marco Salvalaglio — TU Dresden, Dresden 01062, Germany

In polycrystals, which are composed of misoriented grains and grain boundaries (GBs), microstructure evolution primarily occurs through GB migration. It is widely accepted that GB migration is mediated by the flow of line defects with both step and dislocation characters, i.e., disconnections. Numerous phenomena associated with grain boundary (GB) motion can, in fact, be linked to disconnection flow. This presentation discusses novel fundamental aspects regarding how disconnection flow affects overall microstructural changes. First, with a continuum (phase field) model of GBs that accounts for disconnections, we demonstrate that the generation of internal stress (shear coupling) is the primary factor responsible for deviations from classical curvature-driven grain growth observed in recent experiments. The relative impact of other factors is also briefly discussed. Second, through atomistic simulations, a Markov chain model analysis, and an experimental proof of concept, we demonstrate that asymmetric GBs exhibit direction-dependent mobilities and unidirectional motion under oscillatory driving forces or cyclic thermal annealing. This behavior can be attributed to the microscopic structure of GBs affecting the nucleation barriers of disconnections. Additionally, our findings suggest that applying oscillatory driving forces and non-equilibrium thermal fluctuations accelerates grain coarsening in microstructures, a conclusion further supported by numerical simulations.