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Rotation-induced grain growth and stagnation in phase-field crystal models JENS TARP, MATHIAS BJERRE, Niels Bohr Institute, University of Copenhagen, LUIZA ANGHELUTA, Physics of Geological Processes, Department of Physics, University of Oslo, JOACHIM MATHIESEN, Niels Bohr Institute, University of Copenhagen — Polycrystalline microstructures are typically formed by thermal processes such as quenching or annealing of melts, through the nucleation and growth of grains of different crystallographic orientation. Since these microstructures have a controlling role on the large scale material properties, it is crucial to understand their formation and late stage evolution. Here we consider the grain growth and stagnation in polycrystalline microstructures using a phase-field crystal model. We identify a transition from a grain growth stagnation upon deep quenching below the melting temperature T_m to a continuous coarsening at shallower quenching near T_m. We find that the grain evolution is mediated by local grain rotations. In the deep quenching regime, the grain assembly typically reaches a metastable state where the kinetic barrier for recrystallization across boundaries is too large and grain rotation with subsequent coalescence or boundary motion is infeasible. For quenching near T_m the grain growth depends on the average rate of grain rotation, and follows a power-law behavior with time, with a scaling exponent that depends on the quenching depth.

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