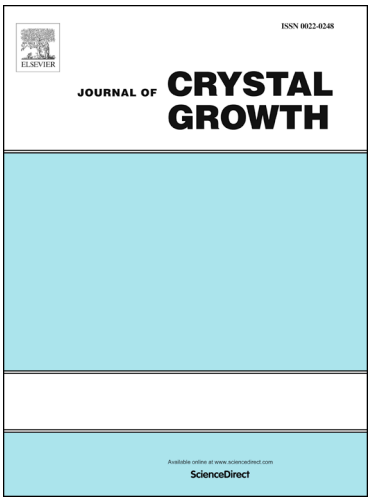

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Graph-based investigation of three-dimensional microstructure rearrangement during ternary eutectic directional solidification of Al-Ag-Cu

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Abstract

In order to control macroscopic material properties, it is important to understand the fundamental mechanisms of microstructure evolution during solidification. Varying the solidification velocity in eutectic alloys can result in both a change in microstructural length scale and different patterns. In a structure consisting of rods or fibers aligned in the growth direction, the adjustment mechanisms for this kind of pattern evolution consist of merging and overgrowing events for coarsening, and splitting and nucleation events for refinement. To gain a better understanding of these mechanisms during three-dimensional ternary eutectic solidification, the distribution of these four types of events is quantitatively assessed using graph based analysis of a three-dimensional data set obtained by synchrotron tomography of a solidified ternary eutectic Al-Ag-Cu alloy. The results demonstrate that the amount of microstructural change events is larger for higher growth velocities. It is found that the microstructure adjustment under steady growth conditions, i.e. constant composition, constant

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