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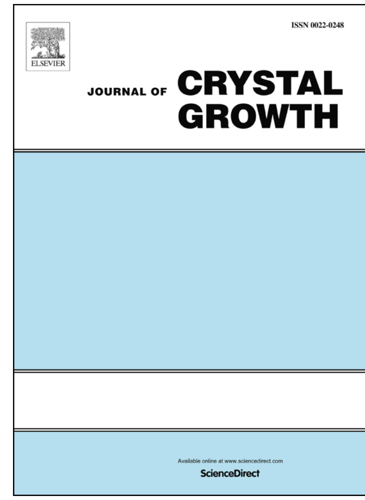

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Growth undercooling in multi-crystalline pure silicon and in silicon containing light impurities (C and O)

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Abstract

Undercooling during the solidification of silicon is an essential parameter that plays a major role in grain nucleation and growth. In this study, the undercooling of the solid-liquid interface during growth of multi-crystalline silicon samples is measured for two types of silicon: pure, and containing light elements (carbon and oxygen) to assess and compare their impact on crystal growth. The solid-liquid interface undercooling is measured using *in situ* and real time X-ray synchrotron imaging during solidification. As a subsequent step, *ex situ* Electron Backscattered Diffraction (EBSD) is performed to obtain information about the crystalline structure, the grain orientation and the grain boundary character. Two main conclusions arise: i) the undercooling of the global solid-liquid front increases linearly with the growth rate which indicates uniform attachment, i.e. all atoms are equivalent, ii) the same trend is observed for pure silicon and silicon containing carbon and oxygen. Indeed, the growth law obtained is comparable in both cases, which suggests that the solutal effect is negligible as concern the undercooling in the case of a contamination with carbon (C) and oxygen (O). However, there is a clear effect of the impurity presence on the crystalline structure and grain boundary type distribution. Many grains nucleate during growth in samples containing C and O, which suggests the presence of precipitates on which grain nucleation is favored.