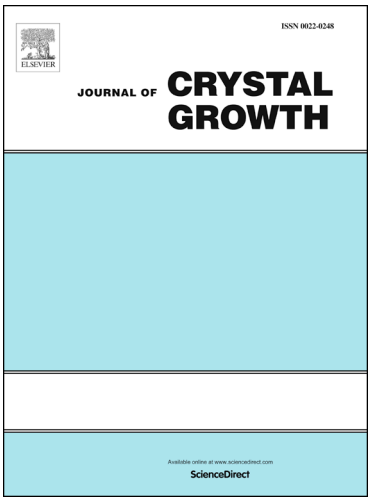

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In-situ detection of convection and rotation striations by growth interface electromotive force spectrum

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Abstract

Nanoscale growth striations, induced by the crystal rotation and melt convection, are in-situ detected by the growth interface electromotive force (GEMF) spectrum during Czochralski (CZ) crystal growth. Specifically, the intensity and period of rotation and convection striations could be precisely revealed under different rotation rates. This is because the GEMF spectrum is affected by the combination effort of temperature difference in crystal rotation path and the melt flow in growth interface. Furthermore, the spectrum analysis (Fourier transform) reveals remarkable characteristics of periodic flow oscillation. More interestingly, in different rotation rates, the corresponding convection period and intensity show particular regularity that could barely be observed in semitransparent and high-temperature melt. Therefore, the GEMF spectrum reflects the subtle changes of a growing crystal that is far beyond the detecting precision of sensors in current CZ equipment. On the basis of this paper and our previous work, the real-time feedback of multiscale striations is established. GEMF spectrum could be a promising approach to reveal striation formation mechanism and optimize crystal quality.

Keywords

A2. Czochralski method, A1. Growth interface electromotive force, A1. Defects, A1. Convection, A1 Fluid flows, A1. Interfaces