Design and Implementation of Hot Zone Structure in Top Seeded Solution Growth of SiC Crystal

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A top-seeded solution growth (TSSG) is a method of growing SiC single crystal from the Si melt dissolved the carbon. In this study, multiphysics modeling was conducted using a commercialized finite element analysis (FEA) package, to get analytic results about electromagnetic analysis, heat transfer and fluid flow in the TSSG grower. Two hot zone structures were evaluated using the FEA simulation, especially for the temperature distribution, the velocity field, and the carbon concentration in the silicon melt. The results of the simulations revealed significant differences between the two hot zone structures in terms of temperature and carbon concentrations, especially near the interface between the crystal and the melt. SiC crystals were experimentally grown to verify the simulation results with the two hot zone structures. The grown crystals were evaluated to study their surface morphology, crystal quality, and polytype stability by using optical microscopy, high-resolution X-ray diffraction, and micro-Raman spectroscopy. The simulations and experiments suggested that the hot zone structure with a small temperature gradient especially near the interface between the crystal and the melt promotes stable conditions for growing SiC crystals via the TSSG method.