Numerical investigation of the effect of the temperature on surface supersaturation in the rapid growth of KDP crystals

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Numerical simulations of the turbulent hydrodynamics and concentration in the rapid growth of potassium dihydrogen phosphate (KDP) crystals have been performed. In this work, a quadratic power-law growth model is applied, concerning the mass transfer occurring at the crystal surface during the growth process under low supersaturations. The effects of temperature, rotation rate, and crystal size on the diffusion layer and surface supersaturation distribution which are critically involved in the processes of surface morphological instability and inclusion formation are investigated. And surface supersaturation is calculated using a new boundary condition computational fluid dynamics (CFD) code. The simulation results showed that as the temperature and rotation rate increase, the higher the average surface supersaturation, but the lower the average standard deviation. In addition, the response of the average surface supersaturation on the pyramidal face to the temperature is 1.4~2 times higher than on the prismatic face. This investigation may adjust the parameters of the growth process to obtain a supersaturation that is favorable for crystal growth.