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MODELLING SHAPE OF A SEMICONDUCTOR CRYSTAL, GROWING IN MICROGRAVITY WITHOUT CONTACT WITH CRUCIBLE.

Abstract

At melting of a semiconductor ingot in a crucible, a gas cavity is always presented because the melt density is higher than the crystal density. In view of absence of hydrostatic pressure, the gas cavity can be located in different parts of the crucible that influences the shape of the growing crystal. This situation is of great importance, as it defines the semiconductor crystal properties in many respects. On the one hand, absence of contact with the crucible reduces internal stresses in the crystal and its pollution by the crucible material. But, on the other hand, Marangoni convection arises in the melt under these conditions and it results in micro-inhomogeneity of the dopant distribution and crystal properties. The problem is examined in three stages. First, possible equilibrium shapes of the melt-gas surface are calculated. Secondly, the thermodynamic analysis of the crucible-melt-crystal system is carried out to find the most thermodynamically stable melt shape depending on gas volume and the gap between the triple gas-liquid-solid point and the crucible wall. In third, the growing crystal shape is calculated at supposition of the stable melt shape realization. The performed analysis has shown that the shape of growing crystal is defined not only by the values of wetting and growth angles, but by the design of the crucible as well. Results of calculations with using the model considered are given in comparison with the data obtained in flight experiments during the FOTON-M3 mission.