MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Microgravity Experiments from Sub-orbital to Orbital Platforms (3)

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GESI CRYSTAL GROWTH ABOARD THE FOTON-M3 SPACECRAFT. TENTATIVE ANALYSIS OF THE EXPERIMENT.

Abstract

During FOTON-M3 mission the solid solution Ge1-xSix crystal was grown by Bridgman method. The purpose of the experiment was searching an opportunity for growth in space a crystal without contact to the crucible wall (Detached Bridgman) and to study the influence of the wall contact on the crystal structure and properties. The influence of the translation speed on morphological stability of the crystallization front was studied as well. For this purpose, the translation speed during the crystal growth in this experiment was changed twice: first from 0.6 up to 1.2 mm/h, and then from 1.2 up to 2 mm/h. After the flight, on the same facility the reference crystal was grown by vertical Bridgman method using the technological regime parameters realized during the flight experiment. If the ground crystal has the usual shape for the given method, the flight crystal has a strongly pronounced area of contactless growth. Up to now (February 2009), the first stage of the grown crystals investigation (both flight and reference) has been carried out as well as a preliminary theoretical analysis of the data obtained. In the given presentation two aspects are considered: the shape of the flight crystal and the silicon distribution along the crystal. For an explanation of the flight crystal shape, calculations have been carried out, proceeding from the available data on the growth and the wetting angles for the given melt and crucible material. The calculated minimal crystal diameter differs from the experimental value. The analysis of the possible reasons of this divergence is given. Calculations of silicon distribution along the crystals for conditions of the experiment have also been carried out in approach of complete melt mixing and for conditions of pure diffusion mass transfer. For the reference crystal, there is a good agreement with the calculation data for the case of complete melt mixing. The calculations for condition of pure diffusion mass transfer show that in this case breaks of the silicon distribution profile have to be observed in the points, corresponding to moments of the translation speed changes. The comparison of these theoretical

data with the experimental silicon distribution in the flight crystal is given.