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MICROGRAVITY EXPERIMENTS ON THE COLUMNAR-EQUIAXED TRANSITION IN SOLIDIFICATION OF THE TRANSPARENT ALLOY SYSTEM NEOPENTYLGLYCOL-CAMPHOR

Abstract

Solidification of alloys from the molten state is an important step in the processing route of many cast parts. Among others, the microstructure forming during the solidification process determines the properties of the final product. In technical applications the microstructure is often polycrystalline and consists of dendritic grains of different size, orientation and shape. The columnar-to-equiaxed transition (CET) in dendritic grain growth often occurs in transient solidification conditions (like casting) and denotes a morphological shape change from elongated oriented to more isotropic grains. The transition depends on the alloy properties and the processing conditions, but also on gravity-driven effects like sedimentation/buoyancy of equiaxed grains in the melt or thermosolutal convection, changing the processing conditions. Here we present microgravity experiments on the CET avoiding the gravitational aspects and focusing on the alloy parameters and processing conditions. A transparent organic alloy system Neopentylglycol-(D)Camphor is used, which solidifies like metals, but offers the chance of in-situ and real-time observation of the physical processes involved in the transition. The experiments were carried out onboard sounding rockets. The temperature evolution within a sheet-like solidifying sample is recorded, and details of the solidification process are observed by means of microscopical observation. For the first time all relevant information is available to compare the conditions at the CET with dedicated analytical and numerical models. Here we present a summary of experimental results and a comparison to model predictions.