3rd Annual International Space Station Research and Development Conference

Influence of Containment on the Growth of Silicon-Germanium (ICESAGE): A Materials Science ISS Investigation

M. P. Volz
NASA, Marshall Space Flight Center, EM31, Huntsville, AL 35812, USA

K. Mazuruk
University of Alabama in Huntsville, Huntsville, AL 35762, USA

A. Cröll
Kristallographisches Institut, University of Freiburg, Freiburg, Germany

A series of $Ge_{1-x}Si_x$ crystal growth experiments are planned to be conducted in the Low Gradient Furnace (LGF) onboard the International Space Station. The primary objective of the research is to determine the influence of containment on the processing-induced defects and impurity incorporation in germanium-silicon alloy crystals. A comparison will be made between crystals grown by the normal and “detached” Bridgman methods and the ground-based float zone technique. Crystals grown without being in contact with a container have superior quality to otherwise similar crystals grown in direct contact with a container, especially with respect to impurity incorporation, formation of dislocations, and residual stress in crystals. “Detached” or “dewetted” Bridgman growth is similar to regular Bridgman growth in that most of the melt is in contact with the crucible wall, but the crystal is separated from the wall by a small gap, typically of the order of 10-100 microns. Long duration reduced gravity is essential to test the proposed theory of detached growth. Detached growth requires the establishment of a meniscus between the crystal and the ampoule wall. The existence of this meniscus depends on the ratio of the strength of gravity to capillary forces. On Earth, this ratio is large and stable detached growth can only be obtained over limited conditions. Crystals grown detached on the ground exhibited superior structural quality as evidenced by measurements of etch pit density, synchrotron white beam X-ray topography and double axis X-ray diffraction. The plans for the flight experiments will be described.