N92-23633

MERCURY IODIDE NUCLEATION AND CRYSTAL GROWTH IN VAPOR PHASE (4-IML-1)

Robert Cadoret
University of Clermont-Ferrand
Aubiere, France

The objectives of this experiment are to grow simultaneously three single crystals of Mercuric Iodide (HgI_2) in an imposed temperature profile and to assess the advantages of growth in microgravity on the HgI_2 crystal quality.

Similar experiments conducted on Spacelab 1 and Spacelab 3 demonstrated that it was possible to nucleate and grow monocrystals of HgI_2 using the forced flux method. However the nucleation phase was found to be extremely sensitive to slight fluctuations in HgI_2 concentrations and much more difficult to control than the growth phase of the crystallization process. Growth in microgravity should reduce fluctuations in HgI_2 concentrations and thus decrease the resultant crystal defects. In order to test this hypothesis, a seeded growth of HgI_2 crystals will be performed on IML-1. As shown in Figure 1, the primary equipment used in this experiment is an insulated furnace which contains the samples in three stainless steel cartridges that surround the heating element. Each stainless steel cartridge houses a glass ampoule containing the raw crystals of HgI_2. This arrangement allows three crystal growth experiments to occur simultaneously. The temperature of the source and the temperature of the crystal zone are precisely controlled (±0.1 °C) by the use of two water heat pipes. The outside walls of the glass ampoules are chemically polished in order to get a perfect contact with the cartridges. The sublimation flux is supplied by a HgI_2 source located at one end of each ampoule in a constant temperature zone (Figure 2). Each ampoule has an internal pressure controlled by the introduction of a small amount of Nitrogen (0.3 torr to 1 torr). The ampoules contain Mercury Diodide from different origins (France or USA) and have different vacuum pressures inside. Ampoules used in the second run will have lower pressures than those used in the first run. A total of 6 ampoules will be used. The process is initiated by heating the source material to a temperature of about 100 °C. This results in the source material subliming. Condensation occurs on a 2 mm HgI_2 seed crystal located on a long pedestal or the mid position of the ampoule, in the temperature gradient zone imposed by the heat sink and the operating temperature of the heat pipe furnace. Thus crystal growth is performed in a temperature gradient by physical vapor transport from the source material to the seed crystal. The well-defined temperature profile should allow nucleation and growth of single crystals at low supersaturation. Low supersaturation is required to reduce the probability of defect nucleation at its lowest value. In such a quasi-equilibrium conditions of growth the microgravity environment can prevent defects caused by local gravity induced concentration fluctuations.

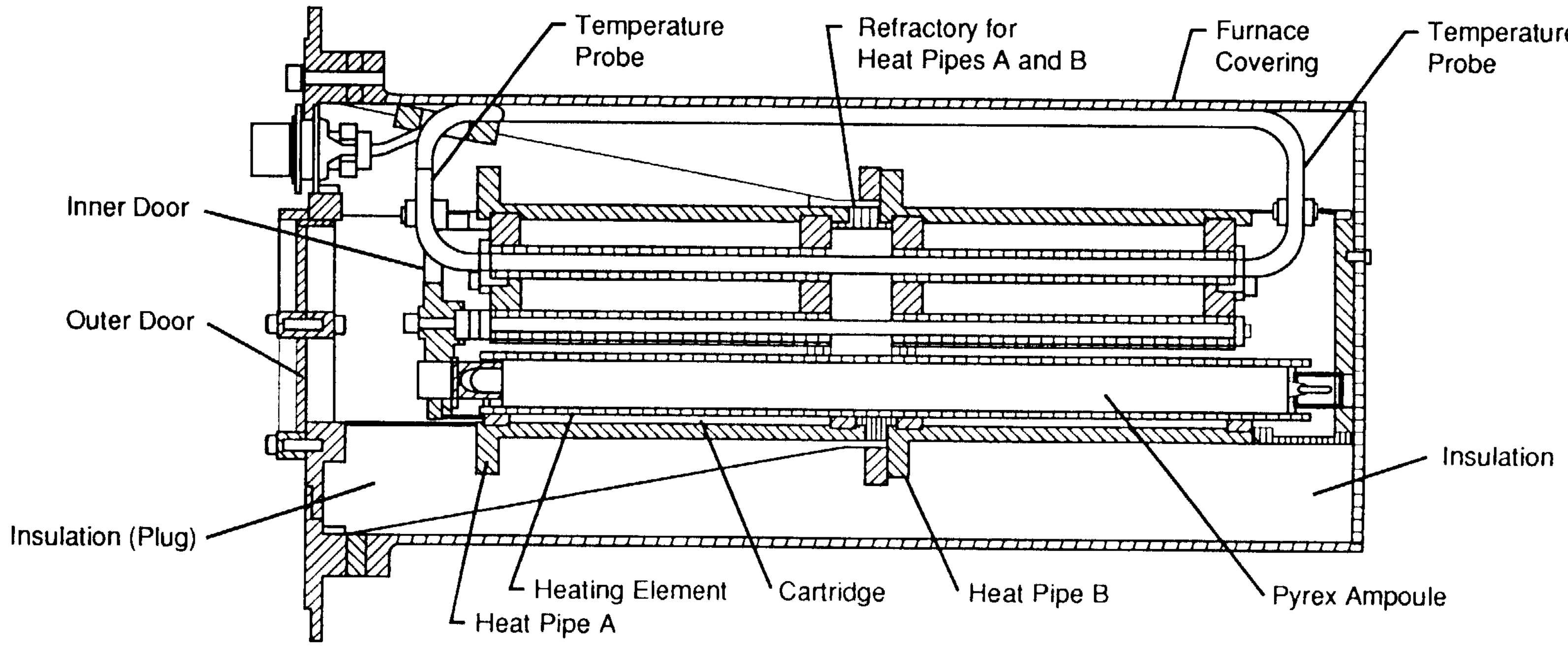

Figure 1. Mercury Iodide Crystal Growth Furnace.

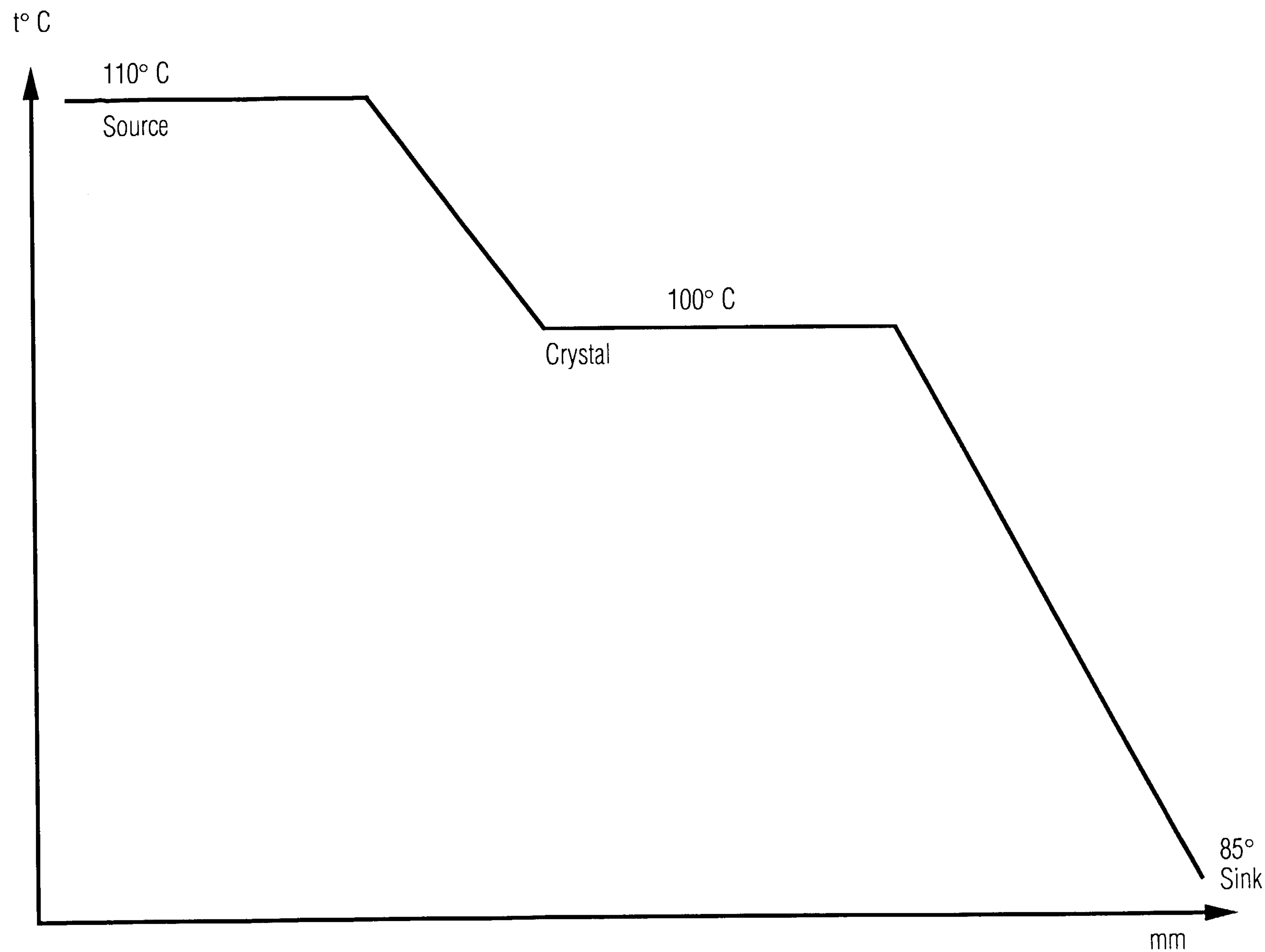

Figure 2. Temperature Profile of the Mercury Iodide Crystal Growth Experiment.