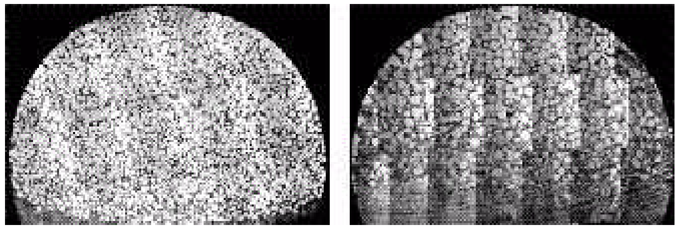
Coarsening Experiment Being Prepared for Flight



50-percent solid-phase sample near surface. Left: Coarsened 10 hr (on Earth). Right: Coarsened 3 days (on Earth).

The Coarsening in Solid-Liquid Mixtures-2 (CSLM-2) experiment is a materials science space flight experiment whose purpose is to investigate the kinetics of competitive particle growth within a liquid matrix. During coarsening, small particles shrink by losing atoms to larger particles, causing the larger particles to grow. In this experiment, solid particles of tin will grow (coarsen) within a liquid lead-tin eutectic matrix. The preceding figures show the coarsening of tin particles in a lead-tin eutectic as a function of time. By conducting this experiment in a microgravity environment, we can study a greater range of solid volume fractions, and the effects of sedimentation present in terrestrial experiments will be negligible. The CSLM-2 experiment is slated to fly onboard the International Space Station. The experiment will be run in the Microgravity Science Glovebox installed in the U.S. Laboratory module.

The coarsening of particles within a matrix is a phenomenon that occurs in many metallic and other systems. For example, the second-phase particles in high-temperature turbine blade materials undergo coarsening at the operating temperature of the turbine. The coarsening process degrades the strength of the blade because turbine alloys containing a few large particles are weaker than those containing many small ones. Coarsening occurs in liquid-phase sintered materials such as tungsten carbide-cobalt, iron-copper, dental amalgam for fillings, and porcelain. The growth of liquid droplets in a vapor phase that occurs inside rain clouds (particularly near the equator, where the vapor pressure of water is high) is a commonplace example of the coarsening phenomenon. The CSLM-2 study will help define the mechanisms and rates of coarsening that govern all these systems.

In fiscal year 2000, the CSLM-2 project designed the experimental flight hardware. The flight hardware consists of two separable pieces of equipment, the sample-processing unit and the electronic control unit, as shown in the final figure. The sample-processing unit incorporates a small electric sample heater with a water quench system. The heater consists of a circular sample holder plate sandwiched by two thin-film kapton heaters with a circular ring heater around the perimeter. The holder plate has four cylindrical sample holes with five platinum resistance temperature devices for temperature monitoring and control.

The electronic control unit contains the power supply, electrical control, and data storage components. There are three toggle switches on the front of the electronic control unit that allow a crew member to power up the unit, activate the experiment run, and abort the run with quench. There are also three indicator lights and a liquid crystal display (LCD) that show the status of the experiment and the temperatures of the resistance temperature devices in the sample holder. The temperature-time data from the experiment run are stored on a hard disk located in the electronic control unit and telemetered to the NASA Telescience Support Center after experiment completion.

The CSLM-2 experiment runs do not need to be attended by an astronaut after activation. There is no need for real-time orbit-to-ground telemetry directly from the experimental apparatus. Non-real-time data will be downlinked via the Microgravity Science Glovebox laptop connected to the CSLM-2 hardware by a RS-422 data downlink.

CSLM-2 hardware mockup with cables.

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