REDUCED GRAVITY
SOLIDIFICATION
GRAVITATIONAL EFFECTS
SOLUBILITY

SPACE SHUTTLE MISSION
SPACEBORNE EXPERIMENT
FURNACES
ZINC ALLOYS
LEAD ALLOYS

D12-12

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ABSTRACT FOR THE 1985
GET AWAY SPECIAL EXPERIMENTER'S SYMPOSIUM

TITLE: **United States Air Force Academy's Micro-Gravity Research Using G-0307**

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Introduction

The purpose of ~~this discussion is to report on~~ the current materials research being done in micro-gravity solidification and future experimentation planned on-board a space shuttle mission. is reported

The Department of Engineering Mechanics at the USAF Academy is developing a micro-gravity furnace to be used on board the space shuttle. The micro-g furnace will be used to conduct materials research dealing with such topics as immiscible alloy solidification. The purpose behind this research project is three-fold: first, to develop a simple, inexpensive, an easy to use furnace to conduct space materials research; second, to conduct a solidification experiment on a lead-zinc alloy in space that macrosegregates due to gravity: and third, to provide a research mechanism for students to get involved with space materials research.

The Micro-G Experiment

Besides developing this low cost, simple-to-use materials experimental device, we anticipate this solidification experiment in space will provide data to resolve an interesting debate concerning the feasibility of materials processing in space. There are differing views on whether it is possible to solidify useable alloys in a low gravity environment. One view believes that surface tension forces will dominate over the very low gravity forces and will cause each phase to segregate into spheroidal phases. The opposing viewpoint believes that there are sufficient forces to cause mixing due to laminar thermal currents, surface tension mixing, and acceleration forces.

To show macrosegregation effects as well as surface tension effects, we have tentively selected a lead-zinc alloy. This alloy is of a monotectic binary system that does not mix on Earth. Due to gravitational forces, lead sediments from the zinc mixture resulting in a nearly pure lead at the bottom and nearly pure zinc at the top of the alloy. The specimen will be made up of alternating thin cylindrical disks of pure lead and pure zinc. This preliminary set-up will alloy certain parameters to be initially defined: distribution and composition of phases, surface area and surface area per volume, and a characteristic shape and radius.

The experimental analysis will include a thermodynamic study of the cooling

C-2

curve from tape recorders. At each phase change, latent heat of fusion will be given off during solidification. The degree of disorder or bonding will be compared with on-Earth experiments to deduce the relative amount of bonding. Micro and macrostructural analysis will be done to determine distribution of phases, composition of phases, any eutectic structure present, characteristic shapes, mean phase radius and surface area. The experimental evidence obtained should determine the degree of bonding as well as surface tension and gravity effects.

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