MICROGRAVITY SCIENCES AND PROCESSES (A2)
Facilities and Operations of Microgravity Experiments (5)

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X-RAY DIAGNOSTICS FOR IN-SITU MICROGRAVITY EXPERIMENTS

Abstract

The development of compact micro-focus x-ray tubes and high-resolution digital x-ray sensors has made the utilization of real-time x-ray diagnostics on board microgravity rockets parabolic flights possible. These systems can offer image resolutions down to 5 m. The selection of anode materials for the x-ray tubes offers different radiation spectra that facilitate diagnostics of different materials and composites. High resolution x-ray images can be obtained at speeds up to 3 Hz for extended time periods.

Swedish Space Corporation develops a series of systems for in-situ X-ray radiography diagnostics for metallurgy experiments in order to study solidification phenomena, diffusion reactions and metal foaming in microgravity. These systems are adapted for sounding rocket flight experiments, experiments have also been performed in parabolic flight with good results.

The present status of X-ray diagnostic systems:

- XRMON Metal foam experiment on MASER11 2008 and parabolic flight 2007 and 2009: The experiment used an X-ray system consisting of a tungsten microfocus X-ray source and a high-resolution digital flat-panel x-ray sensor. Images of aluminium metal foam generation and stabilization were recorded at 1 Hz with 20 m resolution during the microgravity phase and stored on board.

- XRMON Diffusion experiment is under development and will be flown on MAXUS 8 in March 2010: For this experiment the same type of X-ray system is used as in the metal foam experiment, with different radiation energy and beam geometry. Three diffusion couples will be studied simultaneously in the same image.

- A Gradient Solidification Experiment is under development for flight on MASER12 spring 2011: This system utilizes a molybdenum microfocus X-ray source. A new digital X-ray camera with increased resolution will be used, featuring a newly developed structured scintillator based on a patented design. The system aims to perform real-time visualization with 5 m resolution of metal structures in an Al-Cu alloy. This has already been verified in a separate feasibility and has already shown that this is possible.

The experiment modules with X-ray radiography are developed under contract from European Space Agency, ESA.

The presentation will focus on the technical part of the experiments and the development of the improved system. The results from the XRMON diffusion experiment to be flown on MAXUS 8 will be presented at the conference.