MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Microgravity Experiments from Sub-Orbital to Orbital Platforms (3)

Author: Dr. Henri Nguyen-Thi
Aix-Marseille Université & CNRS, France

Dr. Guillaume Reinhart
Aix-Marseille Université & CNRS, France
Mr. Georges Salloum Abou Jaoude
Aix-Marseille Université & CNRS, France
Dr. Bernard BILLIA
CNRS, France
Prof. Ragnvald Mathiesen
NTNU, Norway
Dr. Gerhard Zimmermann
Access e.V., Germany
Mrs. Ylva Houltz
Swedish Space Corporation (SSC), Sweden
Mr. Gunnar Florin
Swedish Space Corporation (SSC), Sweden
Dr. Daniela Voss
European Space Agency (ESA), The Netherlands
Mr. Antonio Verga
European Space Agency (ESA), The Netherlands
Mr. Fabio De Pascale
European Space Agency (ESA), The Netherlands

PRELIMINARY RESULTS OF MASER12-XRMON EXPERIMENT ON SOUNDING ROCKET DEVOTED TO THE X-RAY RADIOGRAPHIC OBSERVATION OF GROWTH PROCESS UNDER MICROGRAVITY

Abstract

The present research deals with the solidification of metallic alloys in microgravity environment. On Earth, gravity is the source of various disturbing effects with strong influences on the microstructure formation and thus the final grain structure. Therefore, microgravity conditions is a unique way to achieve idealized conditions, namely when diffusive transport in the melt is dominant. Furthermore, most phenomena involved in solidification are dynamical, such as fluid flow, dendrite fragmentation, grain sedimentation or floatation, bending of secondary arms. Accordingly, it is of major interest to be able to investigate the time-evolution of the growth process. In metallic alloys, this can be achieved by using X-ray imaging.

In the frame of ESA-MAP (Microgravity Application Promotion) project entitled XRMON (In situ X-Ray MONitoring of advanced metallurgical processes under microgravity and terrestrial conditions), a dedicated experimental set-up named XRMON-GF (Gradient Furnace) was developed. XRMON-GF enables us to perform in situ and real time observations of the formation and evolution of solidification microstructures, and leaves us with unique possibilities to analyse dynamical phenomena that occur during

the growth process. With this facility, detailed information will be provided on solidification of metallic alloys hitherto inaccessible with experimental approaches based on post-mortem analysis.

XRMON-GF has recently flown on board MASER 12 sounding rocket, which was successfully launched February, 13th 2012 at Esrange (Sweden). For the first time, a directional solidification experiment with in situ X-ray radiography was carried out in microgravity conditions, when transport by diffusion is dominant. This communication will report on the preliminary results obtained from MASER 12 experiment, which dealt with the directional solidification of an Al – 20 wt% Cu sample. Furthermore, the general capabilities of the experimental setup will be discussed, with several examples where it would be of great interest to perform such in situ studies. A comparison with a reference experiments performed on earth with convecto-diffusive transport in the liquid phase will also be presented, enlightening the effect of gravity during the microstructure formation.