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Author: Mr. Christian Lockowandt
Swedish Space Corporation (SSC), Sweden, clo@ssc.se

Mr. Gunnar Florin
Swedish Space Corporation (SSC), Sweden, gunnar.florin@sscspace.com
Mr. Mattias Abrahamsson
Swedish Space Corporation, Sweden, mattias.abrahamsson@sscspace.com

X-RAY A TOOL FOR 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 sounding rockets and other microgravity platforms possible. These systems can offer image resolutions down to 5 m at up to 6 frames per second for extended time periods. Swedish Space Corporation have during the last years developed a series of systems for in-situ X-ray radiography diagnostics for metallurgy experiments in order to study solidification phenomena, diffusion reactions, metal foaming, etc. in microgravity. These systems have successfully been adapted for both sounding rocket experiments and parabolic flight usage as well as for evaluation work in the laboratory. In the future there could also be used on other platforms as ISS or similar. The following projects have been performed or are on-going: XRMON Metal foam experiment on sounding rocket MASER 11, 2008 and parabolic flights 2007, 2009: Images of aluminium metal foam generation and stabilization were recorded during the microgravity phase. Principal investigator was Dr. Francisco Garcia Moreno at Technical University Berlin. XRMON Diffusion experiment on sounding rocket MAXUS 8, 2010: Three diffusion samples in three separate furnaces were studied simultaneously in the same x-ray image. The science team: Prof. A. Griesche, DLR Metallurgic Institute of Bonn, Germany, Prof. R. Mathiesen, Norwegian University of Science and Technology, Trondheim MAXUS 9, 2017: Six diffusion samples in two separate furnaces with different temperatures performed by Prof. Florian Kargl, DLR Cologne. XRMON Gradient Solidification Experiment on MASER 12, 2012: The system performed real-time visualization of solidification in an Al-Cu alloy. A re-usable module framework "frequent flyer" was developed, including a Bridgman furnace for X-ray usage, enabling in-situ visualisation of directional solidification in microgravity. Principal investigator was Dr Henri Nguyen-Thi, University Paul Cézanne, France. XRMON Isothermal Solidification Experiment on MASER 13, 2015: This experiment will re-use the framework of the XRMON-GF module, but also incorporate an isothermal furnace. Principal investigator is Dr David Browne, University College Dublin, Ireland XRMON Parabolic Flight Facility, June 2013, April and September 2014, April 2016: The same technology as used for the XRMON Gradient experiment, but adapted for parabolic flight environment, including an "easy to use" user interface and provisions for easy adaptations for future furnace developments. XRMON Laboratory Set-up, Trondheim and Marseille 2012: An adaptation of the high resolution X-ray technology for laboratory usage. The XRMON Microgravity Application Program is supported by the European Space Agency.