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Author: Dr. Rainer Wunderlich
Ulm University, Germany, rainer.wunderlich@uni-ulm.de

Dr. Markus Mohr
Ulm University, Germany, markus.mohr@uni-ulm.de
Dr. Ulrike HECHT
Access e.V., Germany, U.Hecht@access.rwth-aachen.de
Prof. Douglas MATSON
United States, Douglas.Matson@tufts.edu
Mr. Michael BRIENZA
United States, mcbrienza@gmail.com
Mr. Alex KLEIN
United States, alex.klein@tufts.edu
Prof. Robert HYERS
University of Massachusetts, United States, hyers@ecs.umass.edu
Prof.Dr. Hans Fecht
Ulm University, Germany, hans.fecht@uni-ulm.de

THE MATERIALS SCIENCE LABORATORY - ELECTROMAGNETIC LEVITATOR (EML) ON THE INTERNATIONAL SPACE STATION: THERMOPHYSICAL PROPERTIES OF A TIAL ALLOY (GE 48-2-2) IN THE LIQUID PHASE

Abstract

In this contribution we describe thermophysical property measurements with the containerless electromagnetic processing device MSL-EML on board the International Space Station ISS. The alloy GE 48-2-2 (Ti48-Al48-2Nb-2Cr) provides a good example of the use of the MSL-EML on ISS. First, the alloy has a high liquidus temperature of 1510 C. Second, Ti-Al alloys are very reactive in the liquid phase. Both properties make processing in conventional thermoanalytic equipment difficult and fraught with error. GE 48-2-2 is an industrial alloy, thermophysical properties are required for modelling of casting and solidification. Moreover, the nucleation kinetics such as the growth velocity and the sequence of metastable and stable phase formation and its possible control by electromagnetic stirring are of interest from an applied point of view, as these mechanisms affect the final microstructure or make necessary elaborate high temperature annealing to obtain the final structural material. But also from a more basic materials science point of view including an investigation of thermophysical properties in the undercooled liquid phase is of interest.
The whole thermophysical property measurement capabilities of the MSL-EML on ISS could successfully be applied to the γ-TiAl alloy providing a set of thermophysical property data and characteristics in an way unprecedented from any device. These were: measurement of the density and electrical resistivity in the liquid phase, surface tension and viscosity by the oscillating drop method, non-contact calorimetry based on electromagnetic induction in the stable and undercooled liquid phase, measurement of the solidification growth velocity and the effect of magnetic stirring on nucleation kinetics and undercooling. An overview of the technical realizations of the different thermoanalytic and kinetic investigations will be presented and selected results of the surface tension and viscosity as a function of temperature will be

discussed.

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