

MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Microgravity Sciences Onboard the International Space Station and Beyond (6)

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THERMOLAB – AN INTERNATIONAL MICROGRAVITY LABORATORY FOR THE
MEASUREMENT OF THERMOPHYSICAL PROPERTIES OF LIQUID METALLIC MELTS ON
PARABOLIC FLIGHTS, TEXUS FLIGHTS AND THE INTERNATIONAL SPACE STATION

Abstract

In the last decade, the thermophysical properties of metallic melts in the high temperature regime relevant for industrial solidification and casting processes were measured with an electromagnetic levitation device EML on board parabolic flights and TEXUS for a series of Ni-, Ti-, Cu- and Fe-based alloys. Parabolic flights provide about 20 seconds of reduced gravity which are sufficient to heat, melt process in the liquid phase and cool a 6 to 7 mm diameter specimen to solidification. In the free cooling phase with the heating field turned off, magnetic field pulses for the excitation of surface oscillations are applied. Because of the considerably reduced positioning forces under micro-g conditions, turbulent fluid flow is absent or strongly reduced, which is a necessary condition for the evaluation of the viscosity from the damping time constant of the surface oscillation. This method is particularly suited for high temperature reactive alloys where container reactions will affect the results obtained with conventional methods such as the sessile drop or rotating cup method for surface tension and viscosity measurements, respectively. The measurement method and data analysis will be discussed. Results for the viscosity and surface tension of the relevant alloys will be presented. The experiments were performed within the framework of the ESA-ThermoLab project which is generally concerned with the measurement of the thermophysical properties of alloys in the liquid phase. More recent results using the MRL-EML device on the International Space Station ISS for extended periods of time will be presented. The international aspects and activities supported by ESA, DLR, NASA, JAXA, SSO, CNES and other agencies will further be discussed.