Thermophysical Property Measurement of Metallic Alloys in the Liquid Phase – Experiments on the International Space Station

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Thermophysical properties of liquid metallic alloys are important as input values for the numerical modelling of casting and solidification and for a better understanding of liquid properties related to the properties of the final cast product such as the glass forming ability of multicomponent metallic alloys. Measurements are complicated by high temperature and high chemical reactivity of many alloys in the liquid phase such as Ti- and Zr-based alloys. This problem can be overcome by containerless processing techniques based on electromagnetic levitation. Microgravity conditions are favourable or required for the measurement of the viscosity, fluid flow investigations,

quantitative non-contact calorimetry and for thermophysical property measurements in the undercooled liquid phase. An electromagnetic processing device has been installed on the International Space station with operations to start in 2015. Alloys to be investigated include Ni-based superalloys, Ti-alloys, generic Fe-alloys as model systems for high alloyed steels, and Zr- and Fe-based bulk metallic glass forming alloys. An overview over the planned experiments, experimental techniques will be given, preliminary results will be presented. Measurements on board the ISS are prepared by short duration microgravity experiments such as parabolic flights, by a ground based measurement programme and by modelling of fluid flow in electromagnetically levitated droplets including investigations of the onset of turbulence and the investigation of fluid flow effects on metastable phase formation and growth. Results of recent parabolic flight experiments will be presented including the surface tension of an FeCrNi alloy and of two γ-TiAl alloys.