Electrical Resistivity

Electrical Resistivity Measurement of High Temperature Metallic Melts

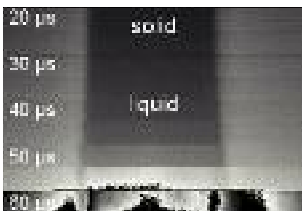
"Electrical Resistivity Measurement of High Temperature Metallic Melts" is the title of a collaboration project of the German Aerospace Center DLR and the Austrian TU Graz, represented by the Workgroup of Subsecond Thermophysics at the Institute of Experimental Physics.

The electrical resistivity of metallic melts is of obvious importance to many liquid metal processing operations, because it controls the melt flow under the influence of electromagnetic fields, e.g., during casting processes, or in crystal growth furnaces. Additionally, via the Wiedemann-Franz law, the knowledge of the temperature dependent electrical resistivity also enables an indirect determination of the temperature dependent thermal conductivity for many liquid metals without disturbances by any convective fluid flow in the sample.

For hot metallic melts containerless handling and measurement methods, as provided in the Materials Science Lab / Electromagnetic Levitator (MSL / EML) facility, are mandatory. In microgravity this facility yields an optimal experimental environment for our intention: The sample is not disturbed by external forces, which otherwise would lead to a distorted shape and to fluid flow in the melt. It is contained in a clean environment and can be processed over a large temperature range. The project is considered as preparation of a µg-experiment in the MSL / EML facility on board the International Space Station ISS. Results of these resistivity measurements shall be used as benchmarks for ground based measurement techniques, as e.g. the fast pulse heating technique.

The fast pulse heating technique is used to rapidly heat metallic samples from room temperature up to the liquid phase. This is achieved by discharging a capacitor-bank over the sample during a defined space of time (typically 50 µs). Heating rates of 108 K/s are reached and data of resistivity and enthalpy as a function of temperature are obtained. Because of that, interactions between the sample and its environment are negligible. Temperature is measured via the thermal radiation of the sample and the thermal expansion is quantified from CCD shadowgraph pictures.

A second part of this collaboration, already proposed as ASAP V project, will focus on measurements of alloys.



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Project duration:
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