Thermal Conductivity Measurements by Non-Contact Modulation Calorimetry Through Magnetohydrodynamic Modeling

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Non-contact modulation calorimetry utilizes electromagnetic levitation in microgravity to investigate the thermophysical properties of metals at elevated temperatures. This configuration is accomplished through modulating the electromagnetic field, inducing changes in the power input to the sample, and thereby, inducing an out-of-phase temperature response. In liquid droplets rather than solid spheres, the fluid flow within the sample changes the internal temperature distribution due to the combined influence of magnetohydrodynamic convection and thermal conduction through the metal. However, measuring the sample's internal flow directly is challenging because of the high temperature, reactivity, strength of the magnetic field, and the opaqueness of the metallic specimens. Nevertheless, to model the droplet's behavior, researchers must account for fluid flow when interpreting results. Thus, employing multiphysics models that incorporate magnetohydrodynamics, fluid flow, and heat transfer is invaluable in data analysis for non-contact modulation calorimetry. The current work is reevaluating historical data from the IML-2 TEMPUS to improve the model accuracy and performance, and in analysis of recent measurements from the International Space Station Electromagnetic Levitation Facility.