The Use of Multiphysics Modeling Assists in Determining the Thermophysical Properties of Liquid Metals Obtained Through Aerodynamic Levitation

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The thermophysical properties of liquid metals are of significant interest in enhancing our understanding of industrial processes like welding or additive manufacturing. These data are also crucial for performing reliable numerical simulations of such processes. At IRDL, we are currently developing aerodynamic levitation to measure the density [1], surface tension [2-3], heat capacity, and viscosity of liquid metals in a temperature range between 1000°C and 3500°C. All experiments are carried out in a controlled atmosphere to avoid any pollution either by contact or from the surrounding gas.

Our approach for measuring surface tension and viscosity involves acoustic excitation to induce the oscillations, sweeping through a range of frequencies. Subsequently, a fast Fourier transform is used to ascertain the drop's resonance frequency. Finally, surface tension is determined using Rayleigh's equation. To estimate viscosity, the relaxation time after the same excitation is studied.

In parallel, a complete finite element numerical modelling describing the experiment is developed, allowing us to study the deviation due to undesirable effects. For example, the model is used to remove or increase the effect of gravity, allowing us to discuss its effect on measurements. This communication will present recent results obtained experimentally with this apparatus and some analysis performed with the help of numerical modelling.