Effects of Oxygen Partial Pressure on the Surface Tension of Liquid Nickel

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The NASA Marshall Space Flight Center's electrostatic levitation (ESL) laboratory has been recently upgraded with an oxygen partial pressure controller. This system allows the oxygen partial pressure within the vacuum chamber to be measured and controlled, theoretically in the range from 10^{-36} to 10^{0} bar.

The oxygen control system installed in the ESL laboratory's main chamber consists of an oxygen sensor, oxygen pump, and a control unit. The sensor is a potentiometric device that determines the difference in oxygen activity in two gas compartments (inside the chamber and the air outside of the chamber) separated by an electrolyte, which is yttria-stabilized zirconia. The pump utilizes coulometric titration to either add or remove oxygen. The system is controlled by a desktop control unit, which can also be accessed via a computer. The controller performs temperature control for the sensor and pump, PID-based current loop, and a control algorithm.

Oxygen partial pressure has been shown to play a significant role in the surface tension of liquid metals. Oxide films or dissolved oxygen may lead to significant changes in surface tension.

The effects of oxygen partial pressure on the surface tension of undercooled liquid nickel will be analyzed, and the results will be presented. The surface tension will be measured at several different oxygen partial pressures while the sample is undercooled. Surface tension will be measured using the oscillating drop method. While undercooled, each sample will be oscillated several times consecutively to investigate how the surface tension behaves with time while at a particular oxygen partial pressure.