View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by NASA Technical Reports Server

The NASA MSFC electrostatic levitation (ESL) laboratory – summary of capabilities, recent upgrades, and future work

Michael P. SanSoucie[1]
David J. Vermilion[1]
Jan R. Rogers[1]

[1]NASA Marshall Space Flight Center, Environmental Effects Branch / EM50, Huntsville, AL, 35812, USA.

The NASA Marshall Space Flight Center (MSFC) electrostatic levitation (ESL) laboratory has a long history of providing materials research and thermophysical property data. A summary of the labs capabilities, recent upgrades, and ongoing and future work will be provided.

The laboratory has recently added two new capabilities to its main levitation chamber: a rapid quench system and an oxygen control system. The rapid quench system allows samples to be dropped into a quench vessel that can be filled with a low melting point material, such as a gallium or indium alloy. Thereby allowing rapid quenching of undercooled liquid metals.

The oxygen control system consists of an oxygen sensor, oxygen pump, and a control unit. The sensor is a potentiometric device that determines the difference in oxygen activity between two gas compartments 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. 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 ESL laboratory also has an emissometer, called the High-Temperature Emissivity Measurement System (HiTEMS). This system measures the spectral emissivity of materials from 600°C to 3,000°C. The system consists of a vacuum chamber, a black body source, and a Fourier Transform Infrared Spectrometer (FTIR). The system utilizes optics to swap the signal between the sample and the black body. The system was originally designed to measure the hemispherical spectral emissivity of levitated samples, which are typically 2.5mm spheres. Levitation allows emissivity measurements of molten samples, but more work is required to develop this capability. The system is currently setup measure the near-normal spectral emissivity of stationary samples, which has been used to take measurements of ablative materials, rocket nozzle coating materials, and materials for spacecraft instruments.