Electrostatic Levitation for Studies of Additive Manufactured Materials

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The electrostatic levitation (ESL) laboratory at NASA's Marshall Space Flight Center is a unique facility for investigators studying high-temperature materials. The laboratory boasts two levitators in which samples can be levitated, heated, melted, undercooled, and resolidified. Electrostatic levitation minimizes gravitational effects and allows materials to be studied without contact with a container or instrumentation. The lab also has a high-temperature emissivity measurement system, which provides normal spectral and normal total emissivity measurements at use temperature.

The ESL lab has been instrumental in many pioneering materials investigations of thermophysical properties, e.g., creep measurements, solidification, triggered nucleation, and emissivity at high temperatures. Research in the ESL lab has already led to the development of advanced high-temperature materials for aerospace applications, coatings for rocket nozzles, improved medical and industrial optics, metallic glasses, ablatives for reentry vehicles, and materials with memory.

Modeling of additive manufacturing materials processing is necessary for the study of their resulting materials properties. In addition, the modeling of the selective laser melting processes and its materials property predictions are also underway. Unfortunately, there is very little data for the properties of these materials, especially of the materials in the liquid state. Some method to measure thermophysical properties of additive manufacturing materials is necessary.

The ESL lab is ideal for these studies. The lab can provide surface tension and viscosity of molten materials, density measurements, emissivity measurements, and even creep strength measurements. The ESL lab can also determine melting temperature, surface temperatures, and phase transition temperatures of additive manufactured materials.

This presentation will provide background on the ESL lab and its capabilities, provide an approach to using the ESL in supporting the development and modeling of the selective laser melting process for metals, and provide an overview of the results to date.