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ELECTRO-MAGNETIC LEVITATOR - A WORKING HORSE FOR MATERIALS SCIENCE EXPERIMENT ON ISS

Abstract

For measuring thermo-physical data at elevated temperatures and studying the crystallisation dynamics of under-cooled melts crucible-free experiments using levitation techniques offer unique opportunities. Applying electromagnetic levitation under micro-gravity conditions the under-cooled regime of electrically conductive materials becomes accessible for an extended time which allows unique investigations of nucleation phenomena as well as the measurement of a range of thermo-physical properties both above the melting temperature and in the under-cooled regime with an accuracy which can not be achieved on ground. Hence, based on a long and successful evolution of electromagnetic levitation facilities for microgravity applications (parabolic flights, sounding rocket missions and Spacelab missions) the Electromagnetic Levitator EML is presently being developed by Astrium Space Transportation under contracts to ESA and DLR. The design of the payload allows flexible experiment scenarios under ultra-high vacuum or ultra clean noble gas atmosphere individually targeted towards specific experimental needs and samples including live video control of the running experiments and automatic or interactive process control. Various stimuli can be applied to the samples for dedicated experiment objectives: Short heater pulses to induce surface shape oscillations, a trigger needle to induce heterogeneous nucleation, or application of a forced gas flow can be used to increase the cooling rate of the sample. Dedicated diagnostics elements are available to measure the physical properties of the sample: Sample temperature is measured by a pyrometer; two video units in orthogonal views provide both high spatial and temporal resolution. Additional capabilities are under discussion which would allow to measure the electrical conductivity of the sample from electrical data of the rf coil system, and to determine the residual oxygen content of the process atmosphere.