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FUTURE CAPABILITIES OF THE ELECTROMAGNETIC LEVITATOR (EML) ON-BOARD THE ISS: OXYGEN SENSING AND CONTROL SYSTEM (OCS)

Abstract

Following several years of development and a launch to the International Space Station (ISS) in 2014, the Electromagnetic Levitator (EML) today is a reliable facility for on-orbit experiments related to materials science of liquid metals, alloys and semiconductors inside the Columbus module of the ISS. In order to keep the facility up to date on scientific level, additional diagnostic capabilities are under development. The Oxygen sensing and Control System (OCS) is an insert that will provide adjustable and defined oxygen partial pressure of the EML processing atmosphere. Oxygen represents a serious and potentially harmful contaminant to many materials at elevated temperatures due to its high chemical reactivity. Especially in containerless materials science experiments in which the processed sample is directly exposed to the process atmosphere and not contained in a cartridge, the presence of oxygen in the atmosphere might lead to a contamination of the sample with oxygen leading to the formation of an oxide layer on the surface or to dissolution of oxygen into the liquid sample. These occurrences could significantly alter the experimental results. The technology used for the OCS is founded on ceramic based oxygen sensors and oxygen pumps and provides adjustable oxygen partial pressure of the processing atmosphere in the range from nominal down to ppb range. The paper provides insight into the scientific background of the oxygen sensors and pumps, the design challenges and solutions for the OCS planned to be implemented on-orbit within the coming years. The project is sponsored by ESA Contract 21788/08/NL/BJ, CCN38.