

Compact Multi-Gas Monitor for Life Support Systems Control in Space: Evaluation Under Realistic Environmental Conditions

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Advanced space life support systems require lightweight, low-power, durable sensors for monitoring critical gas components. A luminescence-based optical flow-through cell to monitor carbon dioxide, oxygen, and humidity has been developed and was demonstrated using bench top instrumentation under environmental conditions relevant to portable life support systems, including initially pure oxygen atmosphere, pressure range from 3.5 to 14.7 psi, temperature range from 50°F to 150°F, and humidity from dry to 100% RH and under liquid water saturation. This paper presents the first compact readout unit for these optical sensors, designed for the volume, power, and weight restrictions of a spacesuit portable Life support system and the analytical characterization of the optical sensors interrogated by the novel optoelectronic system. Trace gas contaminants in a space suit, originating from hardware and material off-gassing and crew member metabolism, are from many chemical families. The result is a gas mix much more complex than the pure oxygen fed into the spacesuit, which may interfere with gas sensor readings. The paper also presents an evaluation of optical sensor performance when exposed to the most significant trace gases reported to be found in spacesuits. The studies were conducted with the spacecraft maximum allowable concentrations for those trace gases and the calculated 8-hr. concentrations resulting from having no trace contaminant control system in the ventilation loop. Finally, a profile of temperature, pressure, humidity, and gas composition for a typical EVA mission has been defined, and the performance of sensors operated repeatedly under simulated EVA mission conditions has been studied.

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