Paper ID: 66862
oral

IAF SYMPOSIUM ON COMMERCIAL SPACEFLIGHT SAFETY ISSUES (D6)
Commercial Spaceflight Safety and Emerging Issues (1)

Author: Prof. Subith Vasu
University of Central Florida (UCF), United States, subith@ucf.edu

MULTI-SPECIES LED MID-INFRARED FIRE SENSORS FOR SPACE HABITATS AND VEHICLES SAFETY

Abstract

In order to further extended deep space exploration missions, both through commercial space endeavors and through government-funded opportunities, the hazard of toxic gas accumulation onboard space vehicles must be quickly resolved to ensure mission success. Such events can occur due to fire events or fuel/oxidizer leaks. Several hazardous gases that are present in a space environment have absorption features in the mid-infrared range and thus can be detected and quantified via absorption spectroscopy.

This work presents a benchtop sensor that utilizes a 4.2m light-emitting diode (LED) and a rotating diffraction grating to detect both carbon dioxide (CO2) and nitrous oxide (N2O). Subsequent works will focus on adding further species of interest and post benchtop testing. An LED-based absorption spectroscopy sensor was developed and was proven functional for detecting CO2 and N2O in a laboratory environment. The grating design proves to be an effective method for using a single LED to detect multiple gases with absorption features at different wavelengths. While detection of both gases does not occur simultaneously, test time required for a full-range sweep can be ultimately reduced by optimizing wavelength range such that more tests are taken in a small range of interest and coarser measurements are taken elsewhere. Additionally, the technique of scanning across a wavelength range minimizes the potential for wavelength drift. This setup could also easily be expanded to include multiple LEDs centered at different wavelengths and ultimately expand the range of detectable gases.

The successful testing in a laboratory fume hood introduces the potential for eventually using a similar setup to replace existing expensive and fragile sensor designs onboard space vehicles. As the complexities and costs associated with these basic safety measures deceases, the potential for commercial space travel increases. Future work planned for this sensor includes increasing the wavelength test range while also decreasing the wavelength interval between test points. The eventual goal is to also test for other hazardous gases, such as Carbon Monoxide (CO). Additionally, this design should complete tests in harsher environments in order to further prove its capabilities.

Acknowledgements: Research at UCF was supported by Financial assistance from Federal Aviation Administration Center of Excellence for Commercial Space Transportation (FAA COE-CST) with Ken Davidian as program manager, Florida Space Institute (FSI), NASA Florida Space Grant Consortium (FSGC), the UCF Mechanical and Aerospace Department, and the UCF Office of Research and Commercialization.