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Hazardous Gas Detection Sensor Using Broadband Light-Emitting Diode-Based Absorption Spectroscopy for Space Applications

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Abstract

As space travel matures and extended duration voyages become increasingly common, it will be necessary to include arrays of early fire detection systems aboard spacefaring vessels, space habitats, and in spacesuits. As gasses that are relevant to combustion and pyrolysis have absorption features in the mid-infrared range, it is possible to utilize absorption spectroscopy as a means of detecting and quantifying the concentration of these hazardous compounds. Within this work, a sensor for detecting carbon dioxide has been designed and tested autonomously on a high-altitude balloon flight. The sensor utilizes a 4.2- μm light-emitting diode source, amplitude modulation to characterize species concentrations, and frequency modulation to characterize ambient temperature. Future work will include expanding the sensor design to detect other gases, and demonstrating suborbital flight capability.

