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Development and testing of novel LED-based, robust, high-speed, fire detection sensor

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Early detection of the onset of fire and explosions using high-speed sensors has the potential to save lives and property. There is increasing need for sensors of this nature as commercial space travel continues to grow at an accelerated rate. The industry have expressed an interest in a durable, sensitive fire sensor that is cost-effective, and has low power consumption. CO is a partial combustion product while CO_2 represents complete combustion, therefore, knowledge of their concentration evolution with respect to time will provide crucial information regarding the nature of fire. Current sensor utilizes three LEDs, one centered at 3.6um serve as a reference, one center at 4.2 um for measuring CO2, and one centered at 4.7 um for measuring CO. The three LEDs are individually spectrally filtered and spatially collimated; then combined into a single beam to be transmitted through the gas under investigation. After being transmitted through the gas the beam is focused onto a single detector. Each LED's amplitude is modulated at a different frequency so they can be separated by Fourier transform. With this information and a variation of Beer's law we can derive the concentration of CO and CO_2. Current sensor was designed in collaboration and funded, in part, by the Federal Aviation Administration, under the Center of Excellence Commercial Space Transportation (FAA COE CST) research structure. Evaluation of the sensor was performed by extensive lab testing, operation in an environmental chamber, and further validated during a high-altitude balloon flight.