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Mid-infrared absorption spectrometer for multi-species detection using LEDs for space applications

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in the Department of Mechanical and Aerospace Engineering in the College of Engineering and Computer Science at the University of Central Florida Orlando, Florida

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Used Ioffe LEDs: 3.6, 4.2 and 4.7 μm

Conclusions

Current development of the sensor is undergoing an adaptation for space vehicles and any environments that may be encountered during space flight. A high altitude balloon flight has been secured which will allow evaluation of the sensor at altitudes of 35 km (-40°C, 1/100atm). Additional flights are planned to follow and may also include parabolic flights or missions to the International Space Station (ISS). The goal is to develop the hardware so that it is rugged and a viable technology for a variety of sensor applications in a variety of environments. It is, therefore, crucial that the hardware can reject heat at low pressures, survive the low-temperature operation, have low drift (stable output), remain low power, and be insensitive to humidity.

Our results under simulated environmental conditions have shown that LEDs are remarkably easy to operate and maintaine at optimal temperatures during service. The bulk of diffulty encountered in both temperature and power management came from the modules used to drive the LEDs which were selected for rapid development and simplicity. Coupling this with low-power overhead and long-life (high stability) make this technology of great appeal to aerospace applications. As the hardware is further refined, it should become more compact with more efficient multiplexing approaches. This may take the form of tightly spaced arrays of LEDs which use custom integrated lenses. The driving electronics will also need to be refined to a more efficient design as the current system produce excessive waste heat.

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