RAMAN AND FLUORESCENCE LIDAR MEASUREMENTS OF AIRCRAFT ENGINE EMISSIONS

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ABSTRACT

Laser induced spectroscopy has been previously suggested[1, 2] as a means of in-situ remote detection and analysis of the various emissions which are important for atmospheric air pollution control. This paper reports experimental laser induced Raman and fluorescence data which was obtained from the exhaust of a gas turbine, aircraft engine.

The experimental lidar unit which was used has been previously described.[3, 4] It consists of a 0.5 watt average power pulsed nitrogen laser, a 24-inch diameter receiver telescope and a 1 meter double, scanning spectrometer for spectral analysis. The entire system operation is controlled by computer, including calibration, data collection and data analysis.

In addition to the usual Raman type spectrum, a broad-band spectrum was produced which extended from the laser excitation wavelength of 3371 Å to beyond 5000 Å. Such a broad emission spectrum is typical of fluorescence from a mixture of unsaturated hydrocarbons excited by a 3371 Å source. The amplitude of this fluorescence spectrum correlated with the hydrocarbon emissions concentration over a

concentration range of 3 orders of magnitude, from "idle" to "full power".

With a 3 nanosecond detection time gate, an analysis of the time dependence of the laser induced signals indicated both a prompt component and a delayed component with a time constant the order of a few nanoseconds. Using a pulsed nitrogen laser pumped dye laser, time dependent emission data was also obtained as a function of the energy of the incident photon.

The factors which limit the lowest values of concentration of gas species which may be detected by a Raman lidar will be discussed. The system noise sources and their fluctuations are shown to determine the detectable limits of CO, NO, CO_2, NO_2 and C_xH_y.

REFERENCES

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