HIGH ENERGY TUNABLE INFRARED SOURCE FOR REMOTE AIR POLLUTION MEASUREMENT

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ABSTRACT

Recent theoretical[1] and experimental[2] work indicates that remote air pollution measurement is possible over kilometer ranges for transmitted pulse energies greater than 10 mJ. Pollutant detection of molecules by absorption and proposed eye safety standards force transmitted frequencies to lie in the molecular "fingerprint" region of the infrared between 2 μ and 20 μ . Within this range atmospheric transmittance occurs over the well known windows. To date an adequate tunable infrared source has not been available for remote pollutant measurement by the topographical or differential absorption methods. This paper describes a coherent source which should meet the requirements for remote pollutant measurements.

The coherent tunable source utilizes nonlinear optical techniques to extend the high energy 1.06 μ Nd:YAG pump energy over the infrared spectral region. The principle tuning device is an angle tuned frequency narrowed $LiNbO_3$ parametric oscillator. The oscillator tunes over a 1.5 μm to 4 μm spectral range and operates with a greater than 35% energy conversion efficiency. Its linewidth is controlled by a grating-etalon combination to less than 0.03 cm^{-1} The angle settings for the $LiNbO_3$ crystal and grating are computer controlled through stepper motors.

The $LiNbO_3$ parametric oscillator output is mixed in $AgGaSe_2$ and CdSe to generate an extended 3 μ - 18 μ and 10 μ - 28 μ tuning capability. Again, the angle settings for the mixing crystals are computer controlled. Output energies at 10 pps vary from 30 mJ in the 3 μ to 4 μ region to 2 mJ in the 10 μ - 13 μ region.

For use as a transmitter source for differential absorption, the system has been designed to transmit two pulses spaced 50 μsec in time and tuned on and off the molecular absorption line. The received backscattered signal is converted to digital form and processed by a PDP11E10 computer system. Atmospheric measurements utilizing the complete system are expected in late 1974.

REFERENCES

1. R.L. Byer and M. Garbuny, Appl. Opt., 12, p.1496, (1973).

2. T. Henningsen and M. Garbuny and R.L. Byer, Appl. Phys. Letts., 24, p.242, (1974).