DETECTION OF OZONE BY DIFFERNTIAL ABSORPTION
USING CO_2 LASER

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ABSTRACT

The detection and monitoring techniques of air pollutants using lasers have been discussed previously by a number of authors.[1-4] This paper describes new detection method for O_3 appling a differential absorption technique with the CO_2 laser. A merit of this method using the CO_2 laser is very simple in comparison with one using ir diode lasers and ir parametric oscillators. This method can be used not only for O_3 but also for C_2H_4 and NH_3.

Since O_3 belongs to an asymmetric top molecule, ir absorption spectrums of O_3 in ambient atmosphere show no resolvable fine structure. The ν_3 band of O_3 overlaps a frequency range of the ($00^{\circ}1 - 02^{\circ}0$) band of CO_2 laser. On the other hand, O_3 has not absorption band in a frequency range of the ($00^{\circ}1 - 10^{\circ}0$) band of CO_2 laser. (see Fig.1) By using one laser line in the ($00^{\circ}1 - 02^{\circ}0$) band and one line in the ($00^{\circ}1 - 10^{\circ}0$) band, it is feasible to apply the differential absorption technique to the detection of O_3 in the atmosphere.

Fig.3 shows the block diagram of the detection system. The resonator is constructed for the ($00^{\circ}1 - 02^{\circ}0$) band by a grating (G) and a mirror (M_1), and for the ($00^{\circ}1 - 10^{\circ}0$) band by the mirror ($M_2$), respectively. A chopper is used for an alternate oscillation, and a reflecter is for returning a laser beam. The concentration of O_3 is determined by measuring the intensities at each of the two wave - lengths.

Using a absorption coefficient, measured with the CO_2 laser by the authors (see Fig.2), at the wavelength corresponding to P(14) and assuming 1 km path and $\Delta I / I = 0.01$, the system is estimated to be able to measure the concentration of approximately 0.03 ppm. This value corresponds to the typical concentration in the ambient air. A discussion of the result by these measurement will be presented.

Reference

1) H.Inaba and T.Kobayashi, Nature, 224 (1969) 170

2) T.Igarashi, 5th Conference on Laser Radar, Williamsburg, Virginia, 57 (1973)

3) E.D.Hinkley and P.L.Kelly, Science, 171 (1971) 635
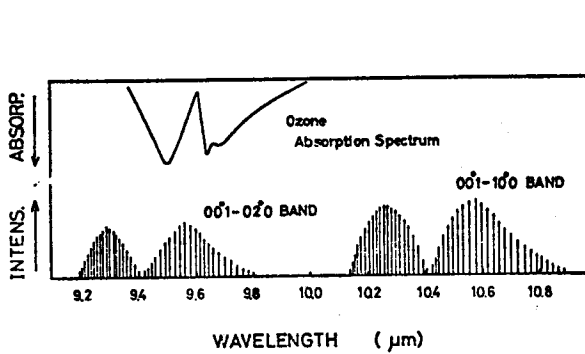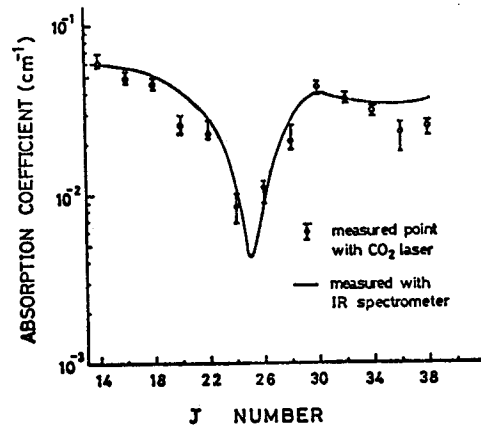
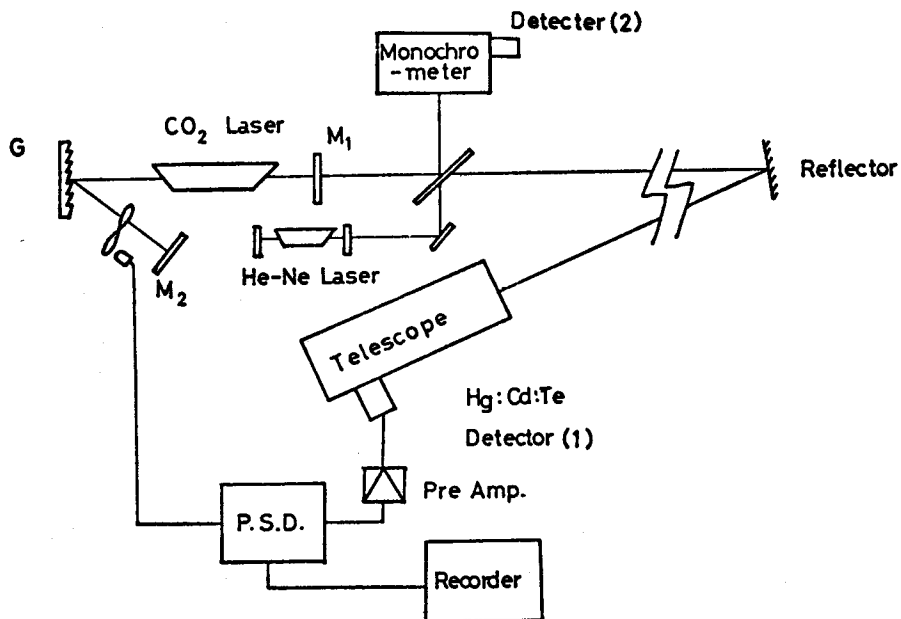4) P.L.Hanst, Appl. Spectro., 24 (1970) 161

Fig.1

Fig.2

Fig.3