

MEASUREMENT OF DEPOLARIZATION AND FLUORESCENCE OF THE CEDAR POLLEN FOR LIDAR APPLICATION

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1 INTRODUCTION

Many particles of pollen fly around in spring and it seems that the cedar pollen causes "hay fever allergy". Recently, the number of its patients increases more and more in Japan. The common method to estimate the quantity of the cedar pollen in the atmosphere is to count the number of the pollen that lies on the glass plate through a microscope. But it is impossible to measure the three dimensional distribution and the time variation of the cedar pollen using this method. Then, we investigate a lidar system to measure the cedar pollen distribution in the atmosphere. In this paper we report about some properties of the depolarization and the fluorescence of the cedar pollen induced from the laser radiation.

2 DEPOLARIZATION OF THE CEDAR POLLEN

It is expected that the depolarization ratio of the cedar pollen is different from other spherical aerosols because of a peculiar shape of the cedar pollen. One of the most important parameters derived from the lidar signal is the linear depolarization ratio δ , defined as

$$\delta = \frac{P_{\perp}}{P_{\parallel}}$$

where, P_{\perp} and P_{\parallel} are powers of the lidar return signals that is polarized orthogonal to and parallel to the direction of the transmitted laser polarization, respectively.^[1] We compared the depolarization ratio of the cedar pollen with the smoke of the cigarette which is one of the aerosols suspended in the atmosphere. Figure 1 shows experimental setup of the depolarization

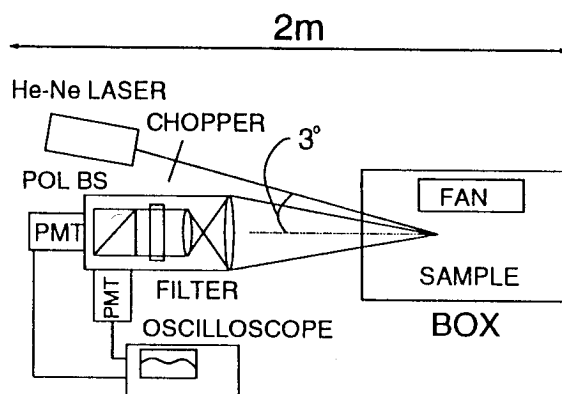


Figure 1 Experimental setup for measurement of depolarization.

measurement. The cedar pollen was fallen quietly into the box. The laser beam of the He-Ne laser with the wavelength of 633nm irradiated the samples in the box. The light backscattered from the samples was divided into P_{\perp} and P_{\parallel} with a polarization beam splitter and detected by photomultiplier tubes(PMT). Concerning to the applications for the lidar, the angle between the laser beam and the scattered light was arranged as narrow as possible. The results are shown in Table 1. There is significant difference between depolarization ratio of cedar pollen and that of smoke. Figure 2 shows the depolarization ratios measured in the different humidity. The depolarization ratio of cedar pollen decreases gradually as humidity increases.

3 FLUORESCENCE OF THE CEDAR POLLEN

The cedar pollen is organic matter, and generally, organic matters is fluorescent. We could observe the laser-induced fluorescence(LIF)^[2] spectrum of the cedar pollen to distinguish from

Table 1 Measured depolarization ratios of the cedar pollen and the smoke of the cigarette.

Sample	δ
cedar pollen	20-45%
smoke of the cigarette	8-10%

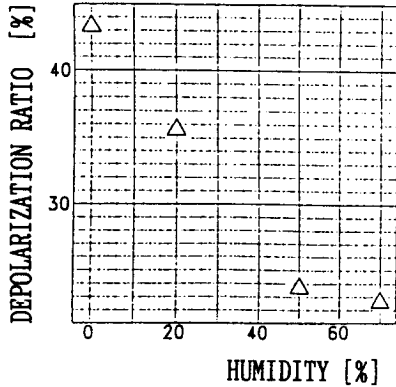


Figure 2 The depolarization ratios of the cedar pollen in the different humidity.

other matters. Figure 3 shows experimental setup of the fluorescence spectrum measurement. We used the third harmonic of the pulsed Nd:YAG laser (wavelength: 355nm) for measurement of LIF of the cedar pollen. The output energy of the laser was 1mJ/pulse. A monochromator was swept with the speed of 2nm/sec from 400nm to 800nm. The fluorescence spectrum of the cedar pollen is shown in Figure 4. This is the characteristic spectrum comparing with other matters.

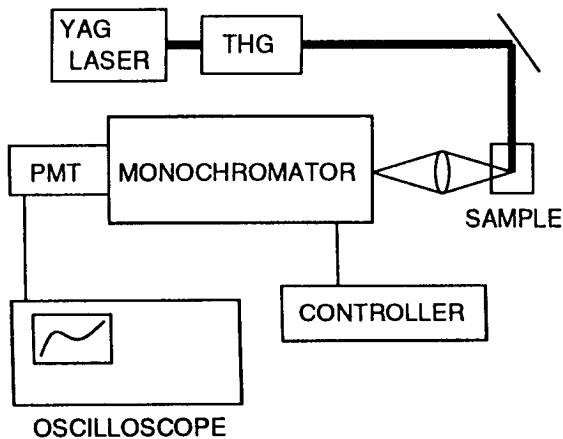


Figure 3 Experimental setup of laser-induced fluorescence spectrum measurement.

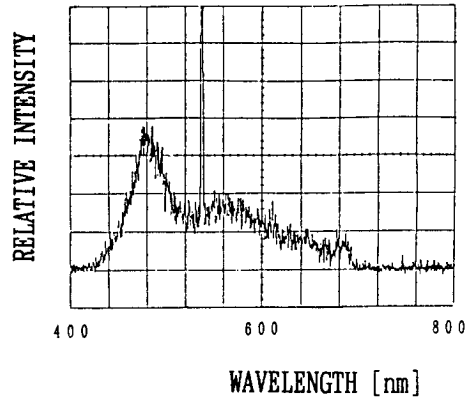


Figure 4 LIF spectrum of the cedar pollen excited by the laser of the 355nm wavelength. The sharp line at 532nm is a leak of the second harmonic of the Nd:YAG laser.

4 CONCLUSIONS

The depolarization ratio of the cedar pollen is higher than that of smoke of the cigarette. The characteristic shape of LIF spectrum of the cedar pollen excited by the 355nm laser appears in the wavelength range of about 450-650nm. The results of these experiments will apply for the lidar to measure the cedar pollen distribution.

REFERENCES

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- [2] Marinella Broglia, "Blue-green laser-induced fluorescence from intact leaves: actinic light sensitivity and subcellular origins", *Applied Optics*, Vol.32, p334(1993).