

## **Fluorescence from Resins for Oil Painting under N<sub>2</sub> Laser Excitation**

Tadaki Miyoshi

*Technical College, Yamaguchi University, Tokiwadai, Ube, Yamaguchi 755*

(Received June 25, 1990; accepted July 21, 1990)

Time-integrated and time-resolved fluorescence spectra were measured at 300 K in resins under N<sub>2</sub> laser excitation. Fluorescence spectra of mastic and dammar are similar to those of varnishes which contain these resins. Fluorescence from lac dye is observed in shellac.

KEYWORDS: resin, varnish, fluorescence, time-resolved spectrum

Fluorescence spectra of pigments and other mediums for painting have been studied.<sup>1-7)</sup> In a previous paper,<sup>7)</sup> the author reported the fluorescence spectra of varnish films using an N<sub>2</sub> laser. Resin is the main ingredient of varnish. However, fluorescence of resin under the N<sub>2</sub> laser excitation has not been reported. In this paper, the author reports on the fluorescence spectra of resins. These spectra are compared with those of varnishes.

Varnish films were prepared on thin Al plate. Fluorescence spectra of resins and varnishes were measured with the following apparatus at 300 K. The excitation source was a pulsed N<sub>2</sub> laser (NDC JS-1000L;  $\lambda = 337.1$  nm, pulse duration = 5ns, repetition rate = 4 Hz). The laser beam was set at an angle of about 40° off the normal incidence to the surface of a sample and was focused on a spot about 1 mm<sup>2</sup> in area by a quartz lens (focal length  $f = 150$  mm). The peak intensity of the laser light on the sample was about 50kW/cm<sup>2</sup>. The fluorescence was collected normal to the sample surface and was focused on the end of an optical fibre by a glass lens ( $f = 70$  mm). The fluorescence was then led to the entrance slit of a 27 cm monochromator (Jarrell-Ash Monospec 27). Fluorescence spectra were measured with an optical multichannel analyser (Princeton Instruments D/SIDA-700).

Figure 1 shows the time-integrated fluorescence spectra of several resins. Fluorescence spectra of varnish films which contain resins were measured. Figure 2 shows time-integrated fluorescence spectra of varnish films: retoucher (dammar), mastic (mastic) and picture copal (copal); resins are parenthesized. The spectra of retoucher and mastic are similar to those of dammar and mastic (resin), respectively. On the other hand, the spectrum of picture copal is different from that of copal. The peak wavelength of the fluorescence from picture copal is longer than that from copal. Picture copal contains stand linseed oil and turpentine. In order to examine the effect of these oils, the fluorescence spectrum was measured in a homemade varnish film which contains the oils and copal. This film shows fluorescence spectrum similar to that of copal alone. This result indicates that the effect of the oils is negligible. Since copal is a general term for rigid resin, the composition of the copal may be different from that of the resin in the picture copal.

Time-resolved fluorescence spectra were measured. Figure 3 shows the time-resolved

spectra of shellac. While a fluorescence band at 630 nm is not so dominant at short delay time, it increases with increasing delay time. The decay times are about 3 ns for the 580 nm band and 5 ns for the 630 nm band. Since shellac contains lac dye, the 630 nm band is considered to be due to lac dye: pigments are laccaic acid and erythrolaccin. The fluorescence of purified lac dye on silk was measured, and a fluorescence band at 625 nm was observed. This result indicates that 630 nm band in shellac is due to lac dye. The 630 nm band is peculiar to shellac, so that this band may be used for the identification of shellac. Time-resolved fluorescence spectra of other resins show behaviours similar to those of the 580 nm band of shellac: the decay time of fluorescence bands is about 3 ns.

In summary, the fluorescence spectra of resins were measured under N<sub>2</sub> laser excitation. Spectra of mastic and dammar are similar to those of varnishes which contain these resins. The fluorescence band caused by lac dye is observed in shellac.

The author is grateful to Ms. W. G. Th. Roelofs of the Central Research Laboratory for Objects of Art and Science in Amsterdam for providing the resins.

## References

- 1) E. R. de la Rie: Stud. Conserv. **27** (1982) 1.
- 2) E. R. de la Rie: Stud. Conserv. **27** (1982) 65.
- 3) E. R. de la Rie: Stud. Conserv. **27** (1982) 102.
- 4) T. Miyoshi, M. Ikeya, S. Kinoshita and T. Kushida: Jpn. J. Appl. Phys. **21** (1982) 1032.
- 5) T. Miyoshi: Jpn. J. Appl. Phys. **24** (1985) 371.
- 6) T. Miyoshi: Jpn. J. Appl. Phys. **24** (1985) 1113.
- 7) T. Miyoshi: Jpn. J. Appl. Phys. **27** (1987) 780.

### Figure captions

Fig. 1. Time-integrated fluorescence spectra of several resins. Peak intensity ratios are as follows: 1 (dammar, mastic, copal, sandarac), 0.5 (colophony, amber) and 0.25 (shellac).

Fig. 2. Time-integrated fluorescence spectra of varnish films. Peak intensities are normalized.

Fig. 3. Time-resolved fluorescence spectra of shellac with a gate time of 5 ns. Peak intensity ratios are as follows: 1 (delay time  $t_d = 0$  ns), 0.2 ( $t_d = 5$  ns), 0.07 ( $t_d = 10$  ns) and 0.03 ( $t_d = 15$  ns).

Fig. 1

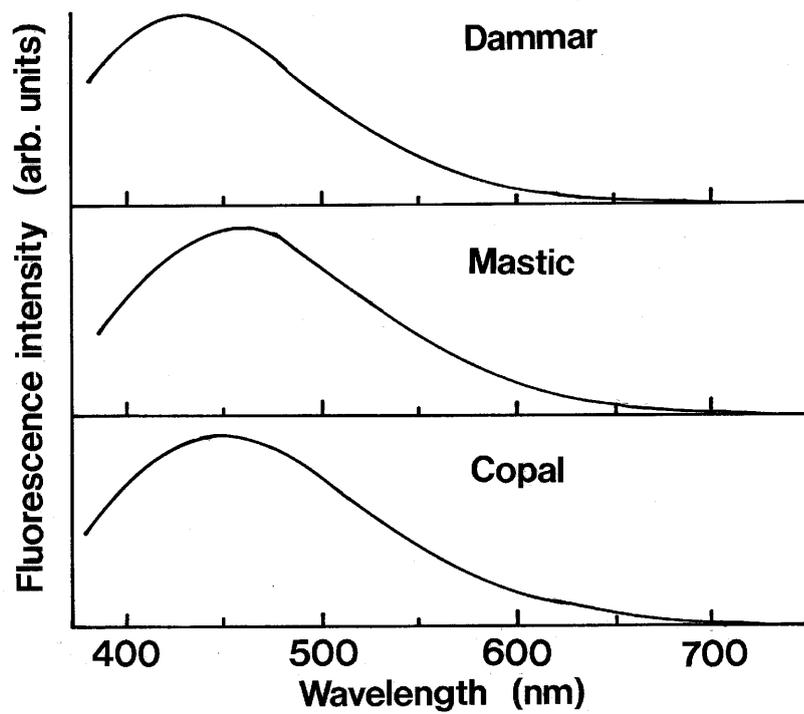


Fig. 2

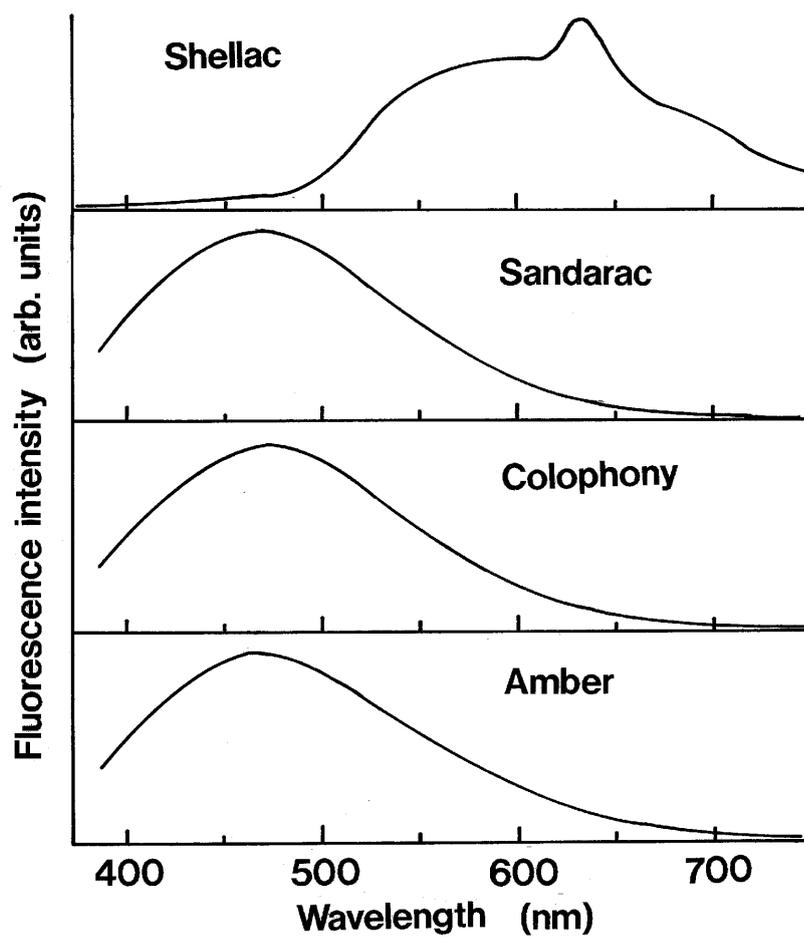


Fig. 3

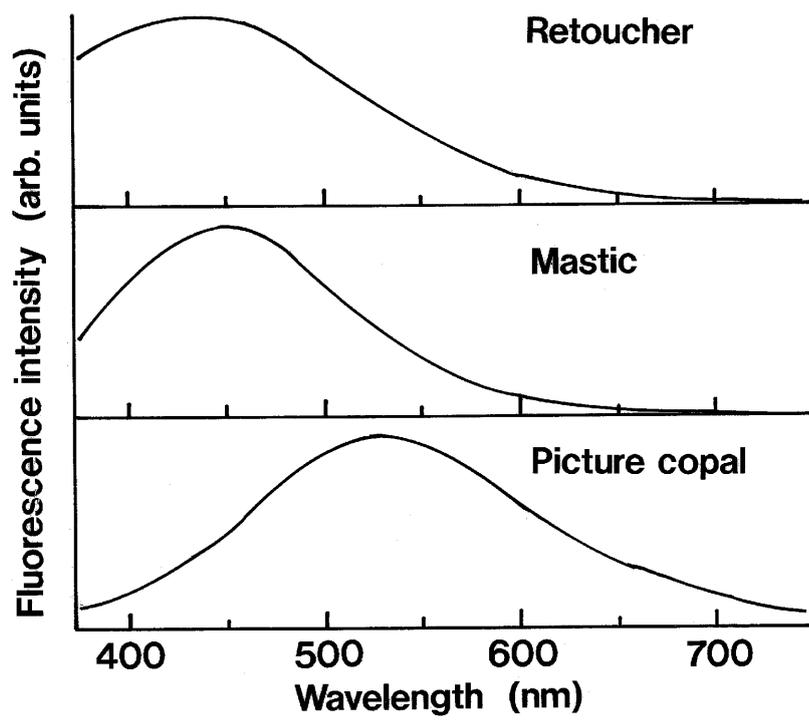


Fig. 4

