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Application News

RF-6000 Spectrofluorophotometer

Measurement of Mineral Fluorescence

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User Benefits

- The excitation wavelength and fluorescence wavelength range of specimens can be checked quickly by using the three-dimensional (3D) florescence spectrum mode search function.
- The fluorescence wavelength range of specimens can be confirmed simultaneously with the excitation wavelength from the (3D) florescence spectrum.
- Mineral samples can be held as-is by using an optional solid sample holder.

■ Introduction

Minerals are compounds that show fluorescence. For example, it is known that calcite, which is composed mainly of calcium carbonate, emits reddish fluorescent light, while fluorite, which consists mainly of calcium fluoride, emits bluish-white fluorescence. Although pure minerals generally show almost no fluorescence, the phenomenon called fluorescence is induced by the mixture of impurities in these minerals.
Minerals that display this kind of fluorescence can be analyzed with a spectrofluorophotometer, which measures the intensity distribution of each wavelength by splitting fluorescent light into its constituent wavelengths. The fluorescence of minerals can also be confirmed with ultraviolent light by using a blacklight, but with a spectrofluorophotometer, it is possible to determine the wavelength at which fluorescent light is emitted, since the incident wavelength can be set arbitrarily.
This article introduces an example of measurement of the fluorescence of minerals using a spectrofluorophotometer.

■ Investigation of Fluorescence Wavelength Range by Using Search Function

Fig. 1 shows the appearance of the minerals used in these measurements. During the measurements, these minerals were held in the sample compartment by using an optional solid sample holder. Fig. 2 shows an image of a sample being held in the sample compartment. The fluorescence/excitation wavelengths of each mineral were confirmed by using the 3D spectrum search function, which makes it possible to search quickly for the optimum fluorescence/excitation wavelengths. (For an image of the search function screen, please see Fig. 3. With the exception of selecting the search range to be scanned, it is not possible to set the scan speed, sampling pitch, or other measurement conditions.)

Fig. 1 Appearance of Minerals Used in Measurements

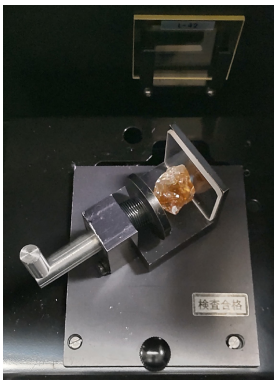

Fig. 2 Image of Mineral Held in Sample Compartment

Although the scanning wavelength range in this experiment was set to 200 to 800 nm, the time required to scan the entire wavelength range was about 80 seconds. The y-axis of the data obtained by measurement of the 3D spectrum shows the excitation wavelength (Ex), and the x-axis shows the fluorescence (emission) wavelength (Em). The color red indicates an area of strong fluorescence, while blue shows a weak area. In the example in Fig. 3, it can be understood that the optimum fluorescence/excitation wavelengths are around 640 nm and 400 nm, respectively.

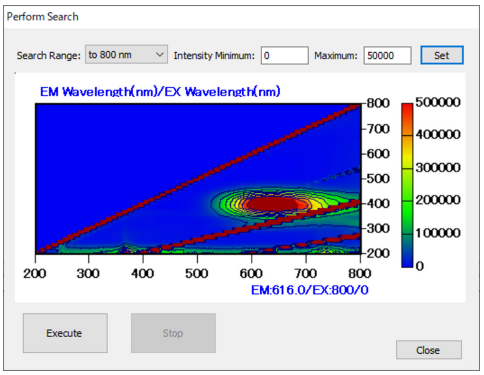

Fig. 3 Search Function Screen of 3D Spectrum Mode

Table 1 Measurement Conditions

Instrument	: RF-6000
Optional accessory	: Solid sample holder
Spectrum type	: 3D spectrum Ex 250 - 500 nm, Em 300 - 550 nm (IHU310) Ex 250 - 500 nm, Em 400 - 700 nm (L42)
Measured wavelength ranges	: Ex 250 - 600 nm, Em 400 - 750 nm (L42) Ex 300 - 600 nm, Em 500 - 800 nm (Y50) Ex 350 - 700 nm, Em 600 - 800 nm (Y50)
Sampling pitch	: Ex 5.0 nm, Em 1.0 nm
Scan speed	: 12000 nm/min
Spectrum bandwidth	: Ex 5.0 nm, Em 5.0 nm
Sensitivity	: Low

■ 3D Spectrum Measurement of Minerals

Filters were set on the fluorescent light side based on the fluorescence wavelength ranges determined by the above-mentioned search function, and the 3D spectra of the minerals were measured under the conditions in Table 1. Fig. 4-1 to Fig. 4-12 show the measurement results for the respective minerals. The excitation wavelengths for emission of fluorescence and the fluorescence wavelength ranges for the minerals can be confirmed from these figures.

Table 2 summarizes the maximum fluorescence wavelength, the fluorescence wavelength range, and the fluorescent color of the minerals for the 3D spectra obtained in Fig. 4-1 to Fig. 4-12. However, these are regarded as reference values, as minerals do not have a uniform in-plane shape, and the measured intensity will differ depending on how the specimen is placed.

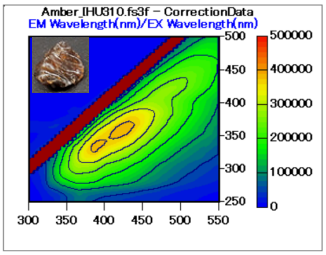

Fig. 4-1 3D Spectrum of Amber

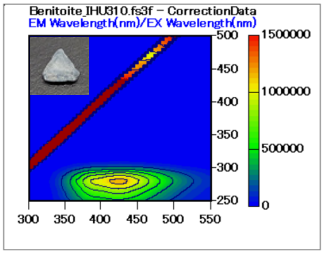

Fig. 4-2 3D Spectrum of Benitoite

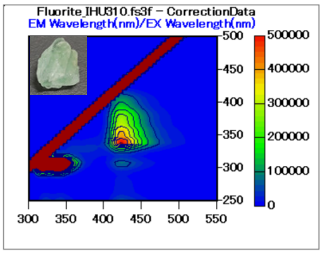

Fig. 4-3 3D Spectrum of Fluorite

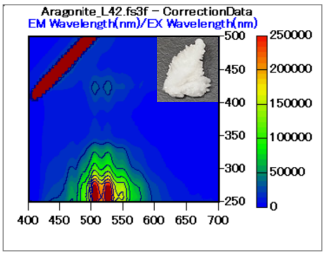

Fig. 4-4 3D Spectrum of Aragonite

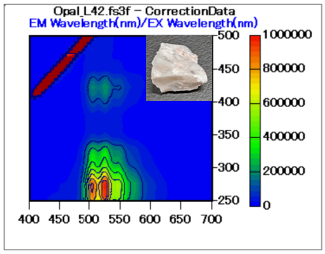

Fig. 4-5 3D Spectrum of Opal

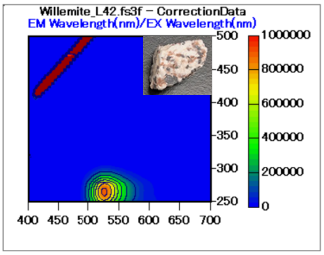

Fig. 4-6 3D Spectrum of Willemite

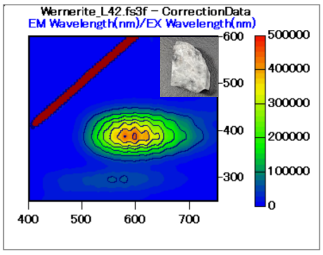

Fig. 4-7 3D Spectrum of Wernerite

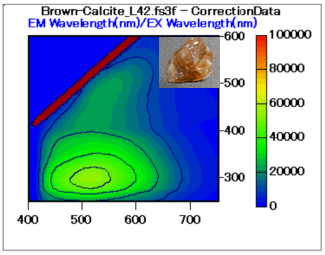

Fig. 4-8 3D Spectrum of Brown-Calcite

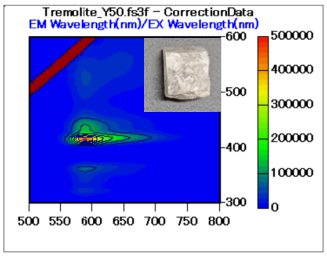

Fig. 4-9 3D Spectrum of Tremolite

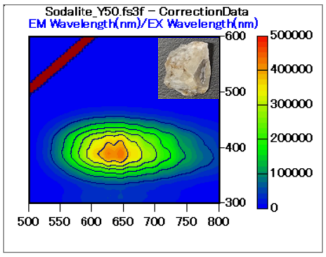

Fig. 4-10 3D Spectrum of Sodalite

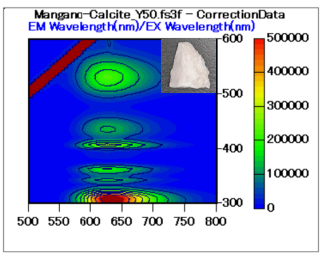

Fig. 4-11 3D Spectrum of Mangano-calcite

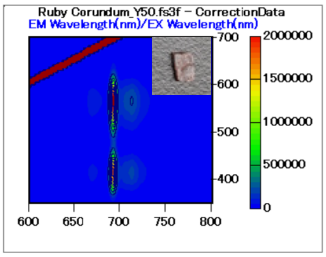

Fig. 4-12 3D Spectrum of Ruby Corundum

Table 2 Maximum Fluorescence Wavelength, Fluorescence Wavelength Range, and Emitted Fluorescent Color of Minerals

	Maximum fluorescence wavelength	Fluorescence wavelength range	Fluorescent color		Maximum fluorescence wavelength	Fluorescence wavelength range	Fluorescent color
Amber	425 nm	330 - 550 nm	Blue	Wernerite	600 nm	505 - 725 nm	Yellow
Benitoite	430 nm	340 - 540 nm	Blue	Brown-calcite	520 nm	430 - 640 nm	Yellow
Fluorite	425 nm	405 - 460 nm (310 - 360 nm)	Blue	Tremolite	590 nm	560 - 690 nm	Orange
Aragonite	505/525 nm	480 - 575 nm	Green	Sodalite	645 nm	535 - 790 nm	Orange
Opal	505/525 nm	480 - 605 nm	Green	Mangano-calcite	630 nm	575 - 725 nm	Pink
Willemite	525 nm	490 - 590 nm	Green	Ruby Corundum	690 nm	685 - 720 nm	Red

■ Conclusion

The fluorescence of various minerals was measured using a spectrofluorophotometer. Not only the fluorescence wavelength range of the sample, but also its excitation wavelength range can be determined simultaneously by measuring the 3D spectrum.

01-00338-EN First Edition: May 2022

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