Measurement of quantum yield in-plane distribution with EEM® View

Technique for calculation of in-plane distribution of quantum yield from fluorescence and reflection images[1)]

A spectrofluorometric microscope (EEM® View) system can observe samples and acquire spectra. Using an integrating sphere, samples can be observed under uniform lighting conditions. The fluorescence spectrum is acquired by the fluorescence-side spectroscope, and at the same time, reflection and fluorescence images from the fluorescent sample are captured by the CMOS camera unit at the lower part of the integrating sphere.
The quantum yield, an indicator of the luminous efficiency of a fluorescent sample, is calculated from the amount of excitation light absorbed and the amount of fluorescent emission. This instrument can determine the in-plane distribution of quantum yield by calculating the amount of absorption from the sample reflection image and the amount of fluorescence from the fluorescence image.

1. Determination of in-plane distribution of quantum yield

- The absorption distribution is determined from the white board image and the reflection image.
- The fluorescence distribution is determined from the fluorescence image.
- The in-plane distribution of quantum yield is calculated from the absorption and fluorescence distributions.

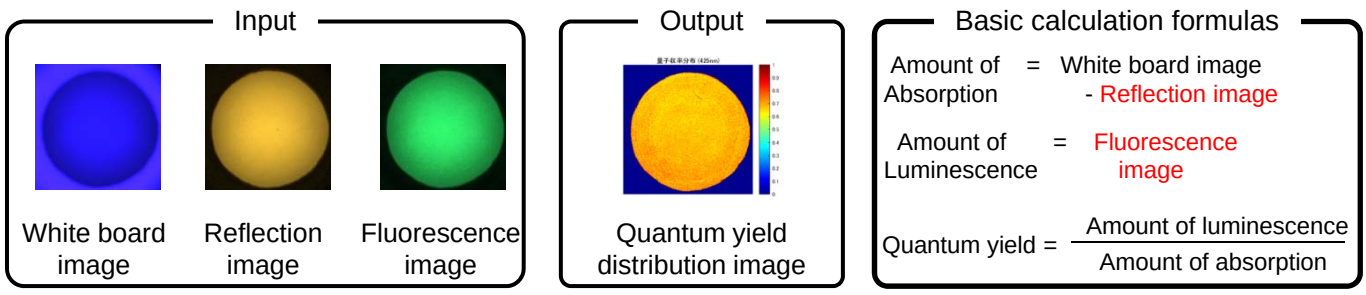

Figure 1 Conceptual diagram for the calculation of in-plane distribution of quantum yield

2. Fluorescence spectrum separation and calculation of in-plane distribution of quantum yield for multiple colored samples

- When multiple fluorescent substances are present, a PARAFAC treatment is performed and the components are separated.
- As a pseudo-sample of composite fluorescent materials, the in-plane distribution of quantum yield was measured for a fluorescent sheet with two colors.

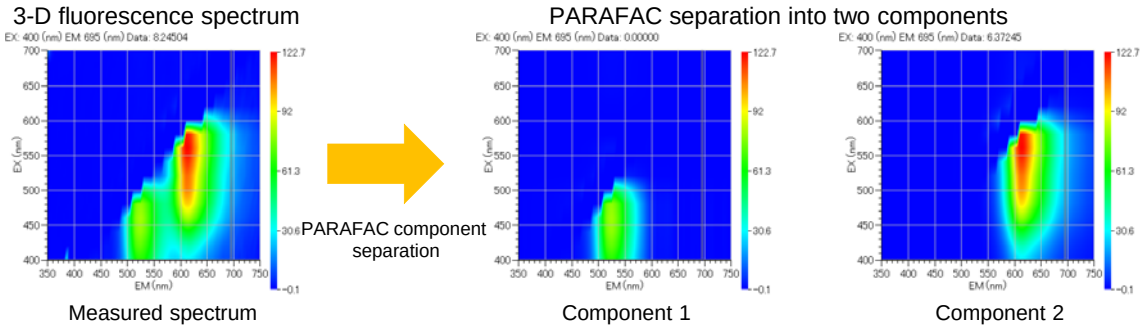

Figure 2 3-D fluorescence spectrum and separated components

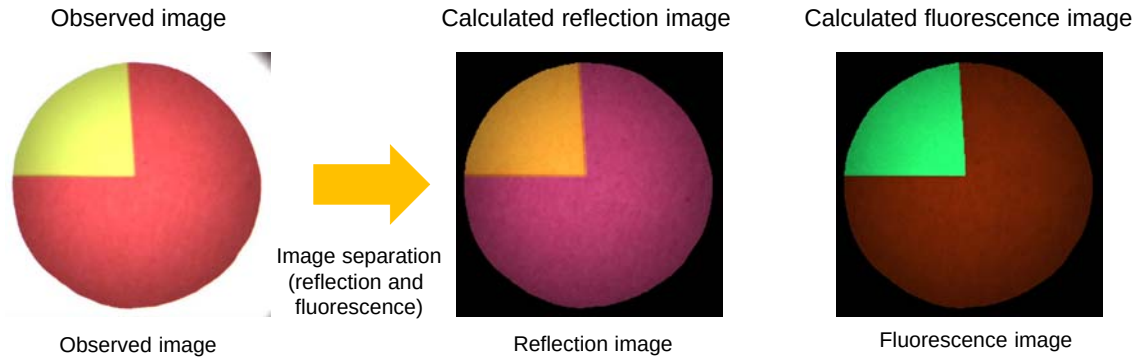

Figure 3 Observed image and calculated reflection and fluorescence images

1) The spectral analysis algorithm was developed as part of joint research between Professor Imari Sato and Associate Professor Yinqiang Zheng of the National Institute of Informatics.

Reflection and fluorescence image separation and calculation of the in-plane distribution of quantum yield for multiple colored samples

Observed and calculated images for sample illuminated with white light and monochromatic light (400 to 700 nm)

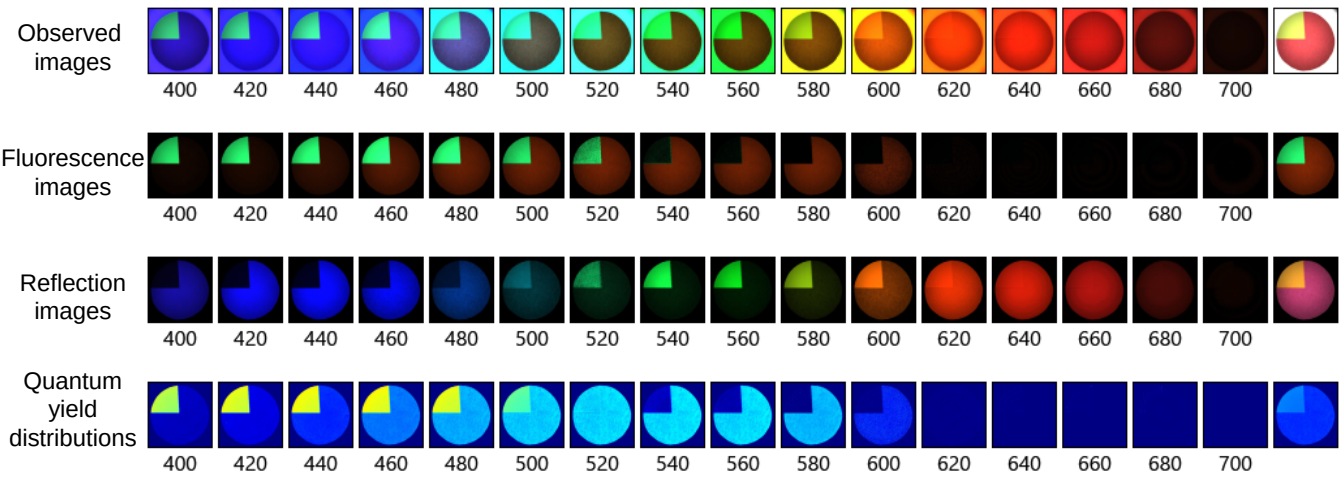

Figure 4 Sample images at different excitation wavelengths

Calculated images and spectra for selected regions

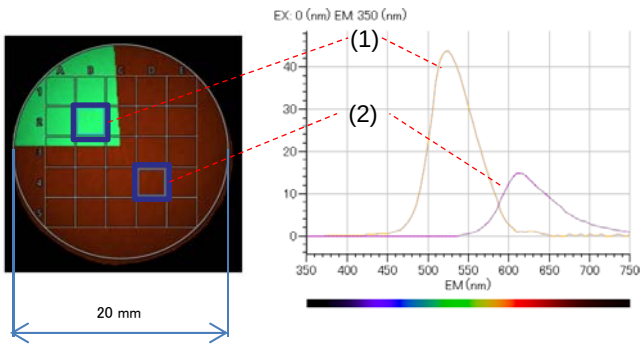

Figure 5 Fluorescence image and spectra

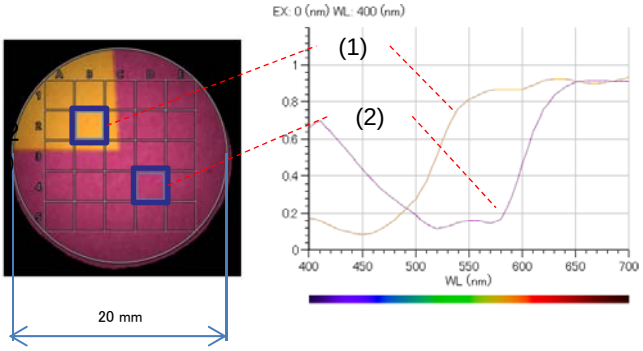

Figure 6 Reflection image and spectra

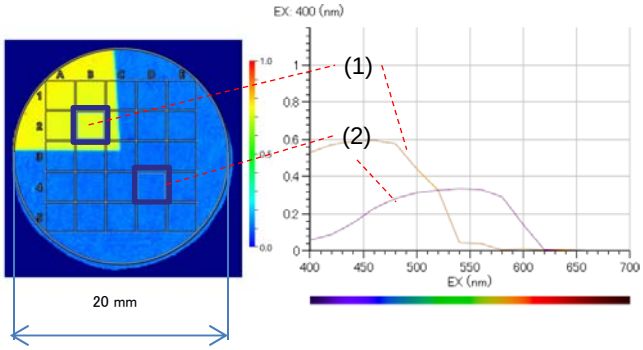

Figure 7 Quantum yield distribution and quantum yields for different excitation wavelengths

(1) Region B2, corresponding to component 1
(see 3-D fluorescence spectrum, PARAFAC treatment)
(2) Region D4, corresponding to component 2
(see 3-D fluorescence spectrum, PARAFAC treatment)

- Multiple captured images were separated into reflection and fluorescence components.
- The in-plane distribution of quantum yield, which is an indicator of the luminous efficiency of a fluorescent material, was calculated.
- The quantum yield was approximately 60% in the yellow region and approximately 35% in the red region.
- The in-plane distribution of quantum yield for a sample can be determined using this method.

[KEYWORDS]

fluorescence spectrum, reflection spectrum, spectral image, spectroscopic camera, image separation, fluorophotometer, F-7000, F-7100, EEM, EEM View, spectrofluorometric microscope, LED, display, fluorescent body, quantum yield, quantum efficiency, in-plane distribution