Measuring Quantum Yields of Powder Samples

Hitachi High Technologies America, Inc.

With new developments in illumination and LED technology, measuring quantum efficiency of materials is an important component for the development of more efficient illumination systems and the reduction of energy consumption. The Hitachi F-7000 Fluorescence Spectrophotometer equipped with a Quantum Yield Measurement accessory has proven to be a useful tool for measuring quantum yields and thus aid in the effort to produce highly efficient sources of illumination. In addition to the high sensitivity and high scanning speed of the instrument, the quantum yield accessory includes a 60mm integrating sphere and software which guides the user during the measurements and performs the required calculations. In obtaining accurate results for quantum yields, spectral correction factors are generated for the full wavelength range of the instrument in advance of the sample measurements. Additionally, since fluorescent radiation from a solid sample changes with direction depending on the condition of the sample surface, correction factors are generated for the integrating sphere involving several measurements which are simplified by the software. This application note specifically describes the analysis of sodium salicylate using the Hitachi Quantum Yield Measurement System.

Quantum Yield Measurement of Sodium Salicylate

Measurement and calculation of quantum yields include the following steps:

1. Set measuring conditions appropriate for the sample.
2. Perform measurements for standard (Al2O3) and sample (Sodium Salicylate) using direct excitation (i.e. samples facing the excitation window).
3. Perform measurements of standard and sample using indirect excitation measurements (i.e. samples facing the emission window).
4. Using the quantum yield measurement software, load the correction factors for the integrating sphere.
5. Perform quantum yield calculation using direct excitation data.
6. Perform quantum yield calculation using indirect excitation data.
7. Utilize the following formula to correct for the indirect excitation effect:

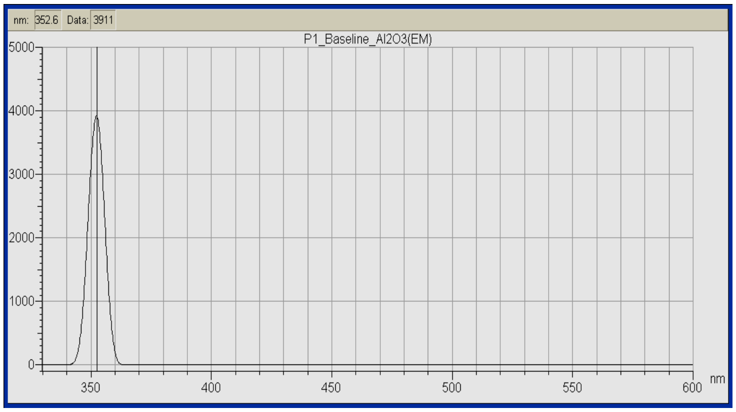
$$\Phi = \Phi d - (1-A_d)\,\Phi_1$$

Φd: QY using direct excitation
A_d: Absorptance under direct excitation
Φ1: QY under indirect excitation

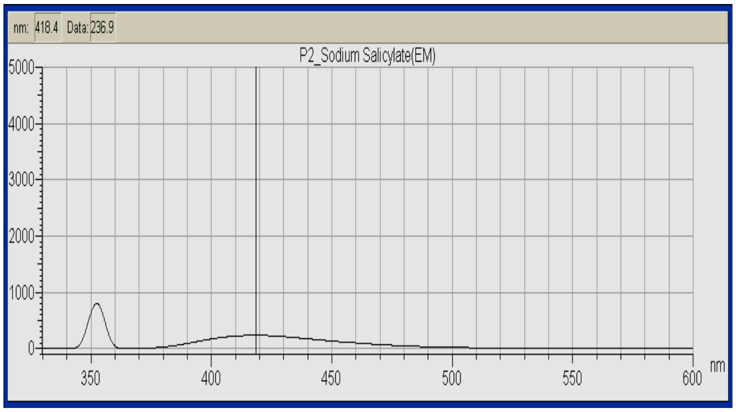
Results and Conclusions

Measurements obtained for the sample were $\Phi_d = 0.530$, $A_d = 0.809$, Φ1= 0.429, which resulted in a calculated quantum yield of 0.45. Thus, it is shown here that the Hitachi Quantum Yield Measurement System is a simple and effective tool for measuring the quantum efficiency of materials.

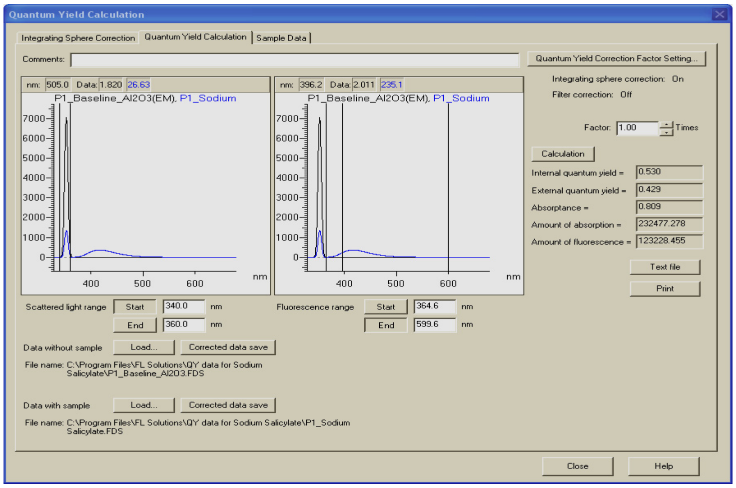
Measurement of standard (Al_2O_3) using direct excitation (Ex: 350nm).



Measurement of sample (sodium salicylate), using direct excitation (Ex: 350nm)



Quantum yield measurement software for simplified analysis and calculations



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References:
1 – FL080002, Hitachi High Technologies Corporation.