

## Analysis of a Fluorescent Material at High Temperatures

### Introduction

The fluorescence components of plasma display panels and white LED's are generally maintained at high temperatures under actual working conditions. However, the evaluation of the characteristics of these materials is often evaluated at room temperature using a standard fluorescence spectrophotometer. The JASCO model FP-6500 with the HPC-503 high temperature sample accessory allows the examination of the fluorescence intensity of powders at temperatures up to 300°C.

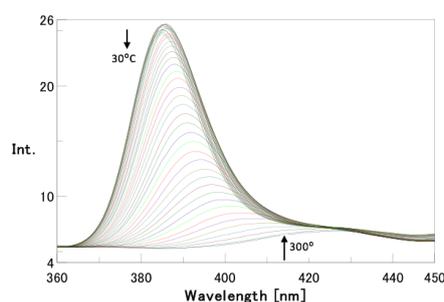


FP-6500 Spectrofluorometer

### Keywords

FP-6500, fluorescence, materials, high temperatures, HPC-503

### Results



**Figure 1.** Fluorescence emission spectra of ZnO powder at varying temperatures (30 °C - 300°C).

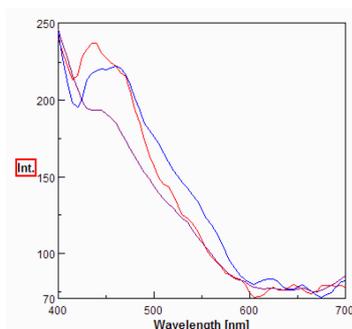
## Experimental

The FP-6200 fluorescence spectrophotometer equipped with a solid sample holder accessory was used for all analyses, shown in Figure 1. The solid sample holder is kinematically mounted in the instrument sample compartment to provide the proper orientation of the sample to the excitation and emission ports. Bills of denomination \$5, \$10, \$20, \$50, and \$100 were placed in the sample holder such that the security thread was exposed to the excitation beam. Emission scans of both sides of each bill were collected and several locations on the security thread for each bill were also examined. The background fluorescence of the bill was subtracted from each scan of the security thread.

Measurement Conditions			
Excitation bandwidth	5 nm	Emission bandwidth	5 nm
Excitation wavelength	365 nm	Emission range	400-600 nm
Data interval	1 nm	Scanning speed	125 nm/min
Temperature Range	15-90°C	Temperature Interval	5°C

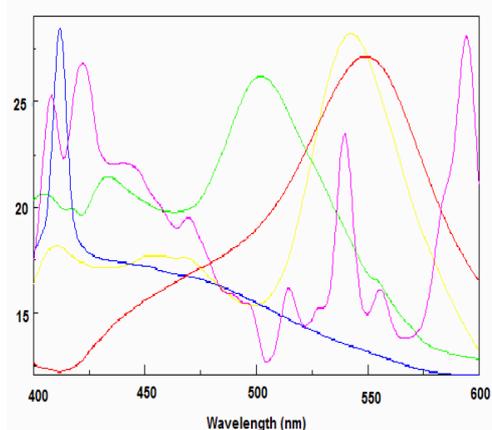
## Results

Figure 2 shows the characteristic background fluorescence of US currency.



**Figure 2.** Fluorescence emission spectra of US (red), Canadian (blue), and Japanese (purple) currencies.

Representative scans of the security threads are shown in Figure 3. The emission bands are wide and distinctly identify each bill. The fluorescence intensity of the security threads appeared to decrease with apparent use and handling of the bills, as newer bills displayed a stronger fluorescence intensity. The fluorescent threads examined in this study did not have a uniform intensity along the length of the thread. This suggests that fluorescence could be used for quality control of the production of these security devices. Table 1 designates the color of the emitted fluorescence of the security threads.



**Figure 3.** Fluorescence spectra of the security threads in a 5 (blue), 10 (red), 20 (green), 50 (yellow), and 100 (pink) dollar bill.

**Table 1.** Emitted color of security threads in US currency.

Denomination	Security Thread Color
5	Blue
10	Red
20	Green
50	Yellow
100	Pink/Orange

## Conclusion

Fluorescence instrumentation can be used to evaluate the authenticity of US currency. The fluorescence intensity of the bill's security thread can be monitored to ensure currency validity and provide a method for the examination of aging of a bill.