UV LEDs in Gem Identification

Searching for a New Standard in Fluorescence Observations

In cooperation with Gemlab Research & Technology

Canadian Institute of Gemmology

BACKGROUND

Commercial "mercury" type SW and LW UV Light Sources

- Developed in 1919 this "black-light" technology is used widely in mineralogy
- Reveals presence or absence of fluorescence in gemstones
- For separation of natural/synthetic/treated diamonds often used as a diagnostic tool

UV LED Technology and Need for New Gemmological Standards

- Narrow spectrum, cool operation, compact size make UV LEDs a preferred technology
- Cost of UV LEDS will rapidly decrease as demand increases
- Will eliminate conflicting testing results but require a new body of reference data

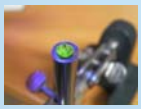
PURPOSE AND HYPOTHESIS

Studies have shown that commercial UV lights containing mercury bulbs may "have several energy levels that bleed or overlap each other " (Williams, 2007). This presentation will attempt to show alternatives and solutions to overcome this problem.

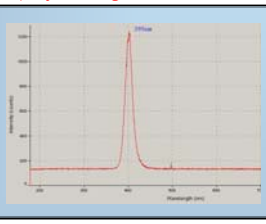
With the advent of UV LED technology it is believed that new reference standards will allow accurate comparison of study results. Deep UV LED's are being developed and a 270nm UV LED is now available for the comparable cost of a "black-light" type UV lamp.

INSTRUMENTS AND METHODS

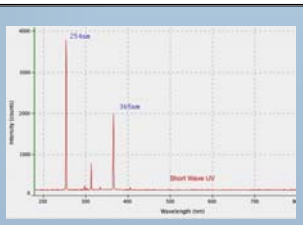
Ocean Optics USB2000 spectrophotometer (200 – 850 nm) with fiber optic probe

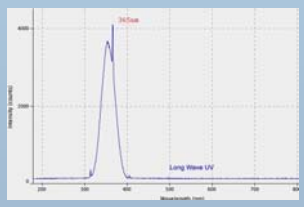


An inexpensive UV LED (~ 395nm) key-chain light



A mercury "black-light" type UV lamp and its emission spectrum for SW and LW setting

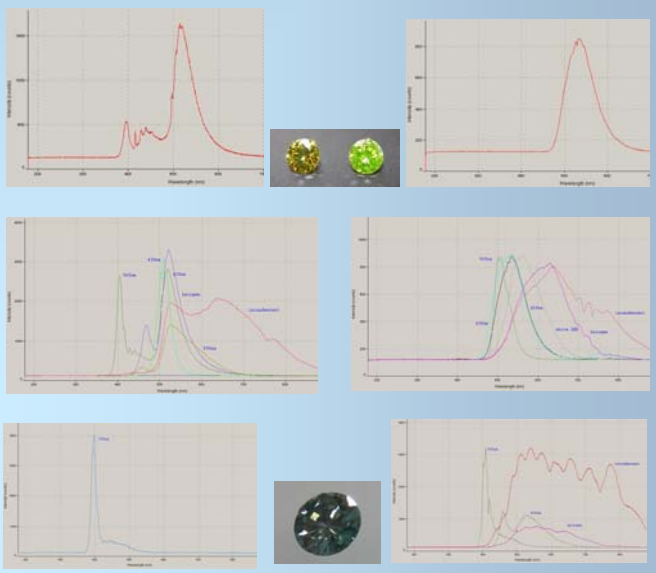




RESULTS

From the emission spectra (fluorescence spectra) - using the commercial UV light (see bottom left) - one can see that the SW light mercury spectrum (left) also shows the 365nm line which is also the designated emission line for the LW test (see spectrum on the right after switching the lamp to LW).

We tested two synthetic yellow diamonds and a cyclotroned blue diamond using various illuminants (incl. red, yellow, green, blue LEDs and tungsten/halogen bulb) and showing their emission shifts. No significant emission shift was obtained from the mercury lamp. The first row shows the results from the ~395nm UV LED.



CONCLUSIONS

The findings comply with the Stokes Law that the emission occurs at a longer wavelength (lower energy level) than the energy source used to excite the stone.

However, due to the lack of a UV standard and an accessible data base the above emission spectra (fluorescence spectra) have similar limited diagnostic value as those obtained from a mercury UV light source.

The advantages of UV LEDs have widely been recognized; they are used in numerous applications in a wide field of industry. It is time for the gemmological community to dedicate more effort to the study of technological advancements.

For further information write to the Canadian Institute of Gemmology, P.O. Box 57010, Vancouver, B.C., V5K 5G6 CANADA or visit the website www.cigem.ca

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BIBLIOGRAPHY

Fox Group of Electronics (2009), Product Description UV LEDs, www.thefoxgroupinc.com

Williams B. (2007), Technology Update-Ultraviolet Light, The Guide, Gemworld International, January/February 2007, pp 8 – 11

All images are from author except LED vs –HP-Hg Lamp (courtesy Fox Group)

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