

1: DISCRIMINATING BLUE GEL PENS WITH THE FORAM



FORAM Raman Spectral Comparator

In recent years, gel pens have become more commonly used by the general public in preference to traditional ball point and liquid ink pens. Gel pens present new challenges to document examiners since many employ inks which are based on pigments, rather than dyes, which cannot easily be extracted for analysis by thin layer chromatography (TLC).

Several scientific studies have been published reporting the use of Raman spectroscopy to discriminate between gel pens. Mazella and Buzzini [1] have applied Raman spectroscopy using two different excitation wavelengths to give a discrimination rate of 68% for pigmented blue gel pens. Zieba-Pulus et al [2] utilised a combined Raman/ μ XRF instrument to analyse a range of materials of forensic interest including blue gel pens.

In this Application Note, we demonstrate the potential of the Foster + Freeman Raman Spectral Comparator (FORAM) to differentiate blue gel pens.

Raman spectroscopy involves the scattering of laser light from a target material, the analysis of which provides the user with a spectral "fingerprint" of the molecular composition of the material.

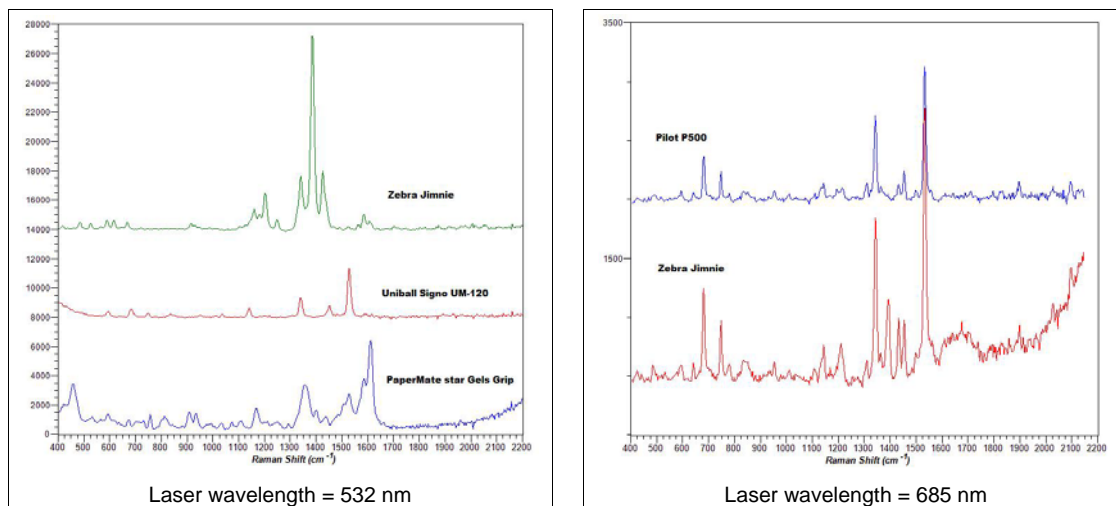
Gel Pens

The study reported here involved subjecting inks from 13 different types of blue gel pen to analysis using the FORAM. Separate Raman spectra were recorded from each of the inks using each of three laser excitation wavelengths: 532 nm, 685 nm and 785 nm. Spectra were baseline-corrected using a propriety fluorescence filter.

| Serial | Name | Ink Type |
|--------|---------------------------|----------|
| 1 | Faber Castell | Unknown |
| 2 | Paper Mate Star Gels Grip | Unknown |
| 3 | Pentel Hybrid K230 | Pigment |
| 4 | Pentel Hybrid KN706 | Pigment |
| 5 | Pilot G-1 0.7 | Dye |
| 6 | Pilot G-2 10 | Dye |
| 7 | Pilot P-500 | Pigment |

| Serial | Name | Ink Type |
|--------|--------------------------|----------|
| 8 | Stabilo PointVisco | Unknown |
| 9 | Uniball Jetstream SX-210 | Pigment |
| 10 | Uniball Signo UM-120 | Pigment |
| 11 | Zebra Jimmie | Pigment |
| 12 | Zebra J-Roller RX | Pigment |
| 13 | Zebra Sarasa | Pigment |

Results and Discussion



Raman spectra of blue gel pens

There are $13 \times 12 / 2 = 78$ sample pairs in the study. Many of the corresponding spectral pairs showed clear differences, yielding the following visual discrimination rates:

| Laser Excitation Wavelength (nm) | Pairs discriminated | Discrimination rate (%) |
|----------------------------------|---------------------|-------------------------|
| 532 | 57 | 73 |
| 685 | 55 | 70 |
| 785 | 56 | 72 |
| Combined | 59 | 76 |

Note that whilst spectra obtained with longer wavelength excitation can provide additional discrimination, the intensity of the Raman emission becomes progressively weaker as the excitation wavelength lengthens.

Conclusions

The FORAM spectrometer has the ability to discriminate between different types of blue gel pens. The use of a number of excitation wavelengths can improve the overall discrimination rate. The instrumentation is cost effective, compact and almost free of maintenance.

References

- [1] W.D. Mazzella and P. Buzzini, Forensic Science International 152 (2005), pp. 241-247.
- [2] J. Zieba-Palus, R. Borusiewicz and M. Kunicki, Forensic Science International 175 (2008), pp. 1-10.

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FOSTER + FREEMAN LTD
 25 Swan Lane
 Evesham
 Worcestershire
 WR11 4PE
 UK
 ☎ + 44 (0) 1386 41061
 📠 + 44 (0) 1386 765351
 sales@fosterfreeman.com
 www.fosterfreeman.com

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**FOSTER + FREEMAN
 USA INC**
 46030 Manekin Plaza
 Sterling
 Virginia 20166
 USA
 ☎ +1 888 445 5048
 📠 +1 888 445 5049
 usoffice@fosterfreeman.com
 www.fosterfreeman.com

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