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APPLICATION NOTE

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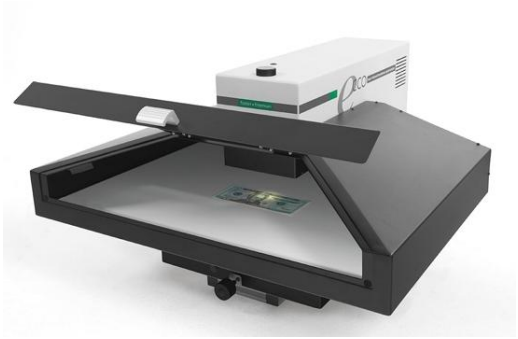
Discrimination of Pencil Lead using the ECCO-DE

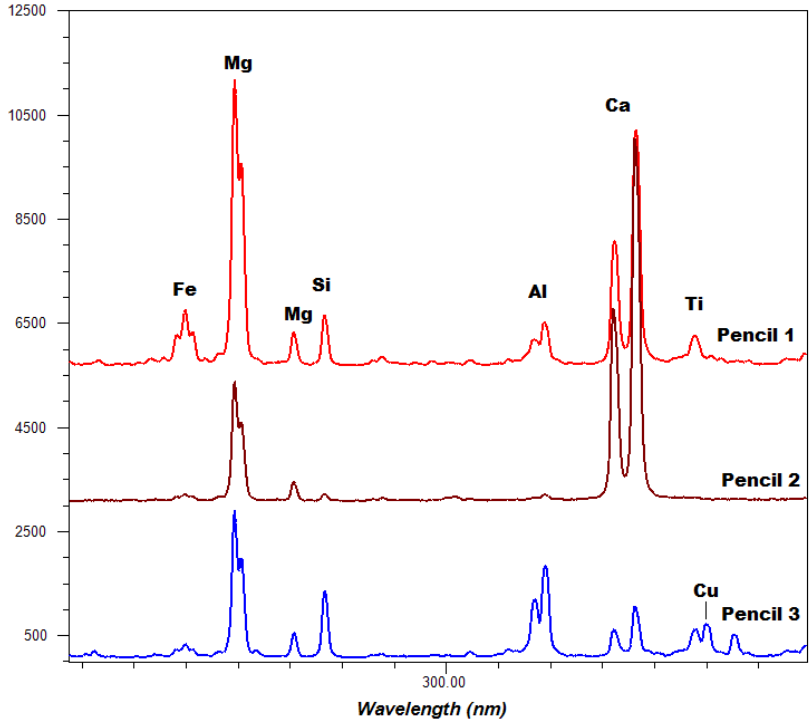


The Foster + Freeman ECCO-DE featuring large document examination bed

Pencil lead is one of the more challenging evidence types encountered by the forensic documents examiner. The inorganic nature of the material means that traditional documents examination techniques such as the Video Spectral Comparison are not applicable. The differences in elemental composition of the lead between different brands means that Laser Induced Breakdown Spectroscopy is an applicable analytical method for discrimination of pencil lead.

In this application note it is shown that the ECCO-DE elemental composition comparator can successfully discriminate pencil lead, based on detecting the following elements Iron, Silicon, Titanium and Copper. Calcium and Magnesium peaks were also observed in the spectra, but were not used in the analysis as these peaks were also visible in the spectra of the paper substrate.

The figure below shows the spectra of three different pencils, recorded from pencil strokes on paper. Each spectrum is an average of 10 laser shots.



Pencil 1 showed detectable levels of iron and titanium, whilst pencil 2 showed a very weak iron peak. Pencil 3 was distinguished based on the presence of copper.

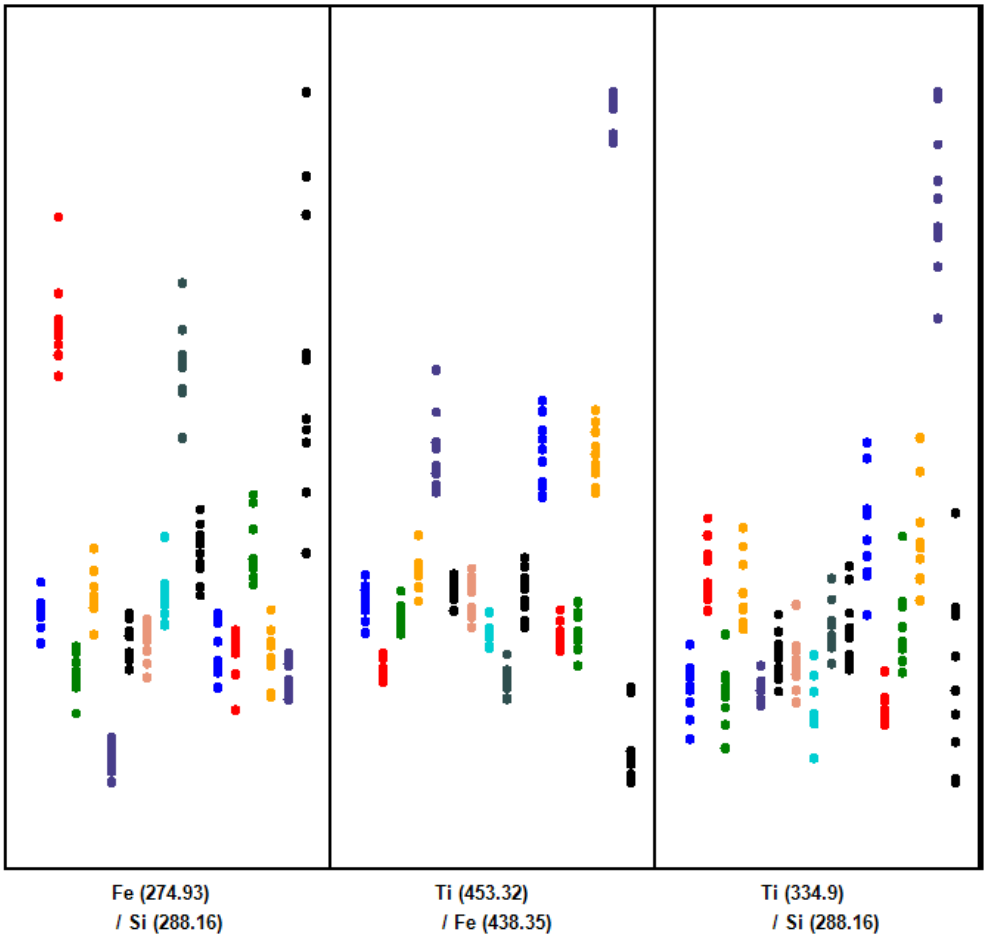
To aid the analysis, peak height ratios of the following peaks were measured

Fe(275) : Si(288)

Ti(453) : Fe(438)

Ti (335) : Si (288)

In a comparative study of 16 different pencil types the differences between the brands is clearly visible when these ratios are plotted



Each dot represents a single shot spectrum, different colour dots relate to different pencil brands.

To aid the analysis Hotelling's multivariate T^2 test[1] was used for discrimination of the ratios. 88 % of the sample pairs were successfully discriminated at 99.9% confidence using this technique.

[1] **CURRAN JM TC, ALMIRALL JR, BUCKLETON JS and WALSH KAJ. The interpretation of elemental composition measurements from forensic glass evidence: I. Science and Justice. 1997;37(4):241-4.**

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