



## Questioned Documents Section – 2010

### J19 Analysis of Writing Inks by Time of Flight Secondary Ion Mass Spectrometry (ToF-SIMS) - A Case Study

*Albert H. Lyter, PhD\*, Federal Forensic Associates, PO Box 31567, Raleigh, NC 27622; and Albert Schnieders, PhD, Tascon USA, 100 Red Schoolhouse Road, Suite A-8, Chestnut Ridge, NY 10977*

After attending this presentation, attendees will learn about the ToF-SIMS instrumentation, its advantages and disadvantages, and its applicability to the analysis of writing inks, as well as, other items of forensic interest. Information and data will be provided that will illustrate the abilities of the ToF-SIMS methodology to solve the "line crossing" problem through the illustration of an actual case example.

This presentation will impact the forensic science community by introducing a unique, surface sensitive, mass spectrometry, ToF-SIMS, and illustrating its application to the solving of a forensic problem.

The analysis of writing inks has garnered extensive interest by the forensic community in regards to differentiation, dating and the solving of problems such as line crossings and obliterations. Various assorted scientific methodologies have been employed such as near infrared imaging, thin layer chromatography, chemical spot tests, high performance liquid chromatography, gas chromatography/mass spectrometry, raman spectroscopy and capillary electrophoresis.

This work will evaluate the capabilities of surface mass spectrometry and especially ToF-SIMS in the analysis of writing inks. ToF-SIMS has several advantages besides the surface sensitivity that will be elucidated, including superior mass resolution, minimal sample destruction, surface analysis, and imaging capabilities. Because of the limited destruction and superior mass range the ToF-SIMS technique is a desirable examination methodology in those instances where the evidence is either extremely limited, as in the case of trace evidence, or extremely valuable, as in the case of antiquities or historical documents. The imaging capabilities of the ToF-SIMS also allow this examination methodology to be used in a court setting where examination results can be easily demonstrated to the trier of fact. One such instance where this circumstance arises is that of a "line crossing." The term "line crossing" refers to an instance where two lines, prepared by either writing or printing, intersect. Historically, microscopic examination has been the technique of choice for this problem, but high instances of inconclusive results and lack of ability to illustrate results has caused continuous research for a better solution. This work will illustrate a series of differences detected by ToF-SIMS among a group of ink formulations. These differences in mass spectra, combined with the ToF-SIMS' surface analysis capabilities, allow for points of comparison that can be used to determine the sequence of application in a "line crossing" problem. **Ink Analysis, ToF-SIMS, Line Crossing**