J24 Analysis of Inkjet-Printed Documents II: Colorant Analysis by Laser Desorption Mass Spectrometry

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After attending this presentation, attendees will have a better under- standing of the method of laser desorption mass spectrometry (LDMS), its utility in the analysis of colorants such as pen inks, and the special challenges that inkjet-printed documents provide.

This presentation will impact the forensic community is in the devel- opment of new tools for the questioned document community for analyzing increasingly complex evidence, such as that generated by a modern inkjet printer.

While LDMS has been demonstrated to be an ideal tool for identifying dyes in pen inks and pigments such as those found in automotive paintings, inkjet printer inks provide unique chemical and physical analytical challenges for this method.

LDMS has been used effectively to identify dyes such as those used in blue, black and red ballpoint pens. It will be also shown that such dyes change with time on paper, and the chemical reaction products can be used to estimate the age of the document. Many inkjet printer inks use dyes, although the dyes are difficult to detect from paper, in contrast to pen ink dyes. It is believed the dyes used are multiply charged dyes that cannot be simply ejected from the surface using a pulsed UV laser, because the multiply-charged dyes adhere strongly to the surface. A number of methods for lowering the charge on the dyes are evaluated, such that they can be analyzed. For example, a given dye may contain four sulfonate groups and may exist as the tetrasodium salt. If ammonium compounds are added to the surface, the ammonium ions can donate protons to the sulfonate groups, resulting in a lower overall charge on the molecule, such that they can be analyzed. LDMS has been able to successfully use LDMS to analyze pigments such as those used in artists' paints, automobile coatings, and in pigmented pen inks. However, there are very specific chemical and physical requirements for a solution to successfully be used as an inkjet printer ink, to allow for picoliter amounts of ink to be deposited on a surface. Manu- facturers report that fine pigment particles, sufficiently small that they will not clog up a printer jet, are coated with charged resin molecules. After ink is deposited on a paper surface, the surface may be further coated with a clear coat by the printer to stabilize the dried ink spots, which may otherwise chip off. Coating on top of coated pigment particles make it difficult for the traditional use of LDMS, since the colorant is under layers of transparent material. In some cases, solvent can be used to expose sufficient amounts of the pigment for LDMS analysis.

Clearly, inkjet printed documents can be mistaken for authentic documents, due to the high quality and resolution of the final product. Chemical analysis as well as physical analysis may be able to link the document with a specific type of printer. LDMS can assist in analyzing the component that can be seen, the colorant - whether it is a pigment such as copper phthalocyanine or dye such as crystal violet.

The impact of this work is the development of new tools for the questioned document community for analyzing increasingly complex evidence, such as that generated by a modern inkjet printer.

Questioned Documents, Laser Desorption Mass Spectrometry, Inkjet Printers

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