Forensics

Ink analysis by easy ambient sonic-spray ionization

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Detection of ink writing forgery in questioned documents is an important area of forensic analysis. Chemical analysis of the ink may provide useful information about the pen used in writing and the age of the documents. Traditional techniques of ink analysis, however, usually require the extraction and/or analyte separation being destructive. Recently, a new family of ionization techniques for mass spectrometry analysis has been introduced opening a new area in the field, that is, ambient mass spectrometry. These techniques, performed at ordinary ambient conditions, provide the desorption and ionization of the analytes directly from their native environment without any sample preparation. The possibility of preserving the sample integrity makes ambient mass spectrometry an interesting tool for forensic purposes such as document analysis.¹ Among the ambient mass spectrometry techniques, easy ambient sonic-spray ionization (EASI) is one of the simplest, gentlest and most easily implemented.² It requires neither heating nor high voltage using a supersonic spray assisted only by compressed N₂ to promote desorption and ionization of the analytes.

Using a homemade EASI source coupled to a single quadrupole mass spectrometer (Shimadzu Corp., Japan), fast and non-destructive fingerprinting identification and aging of ballpoint pen inks has been performed directly from the paper surface under ordinary ambient conditions. First, EASI-MS was used to provide ink chemical profiles from different pens directly from the ink lines on the paper surface. Accelerate aging of these inks has been performed by exposure of ink writings to an incandescent lamp, revealing the degradation behavior of six different ink dyes. Basic Violet 3 degradation, the most common dye in blue pens, showed a linear relationship with time which demonstrates that the cascade of products from dye degradation work as “chemical clocks” for ink aging. Analysis of documents has confirmed the ink aging capabilities of EASI-MS. Intersection of ink lines has also been investigated, and EASI-MS has been able to determine the order of superimposition at the crossing point. For superimposed ink lines, continuous EASI-MS analysis was shown to penetrate through the layers and to characterize each ink layer.

Referências