B159 Using LA-ICP-MS at the Netherlands Forensic Institute

Shirly Montero, PhD, Maarten Hordijk, Jan de Koeijer, Wim Wiarda, Ing, Peter de Joode, Ing, and Gerard van der Peijl, PhD, Netherlands Forensic Institute, Postbus 24044, Den Haag, 2490AA, The Netherlands*

Attendees will learn the discrimination potential of LA-ICP-MS for the elemental analysis of different types of materials of forensic interest.

This presentation will impact the forensic community and/or humanity by demonstrating the discrimination potential of LA-ICP-MS in the analysis of chemical composition of some materials of forensic interest that cannot be discriminated using traditional methods.

Trace evidence is widely recognized for its associative value. Sometimes recovered samples associated with a suspect and samples associated with a known source are compared to each other based on the physical properties as well as their chemical composition. The choice of methods to characterise and compare trace evidence depends on, among other factors, the accessibility of the proper instrumentation (i.e., sensitivity, discrimination potential), the cost of the analysis including analysis time and the characteristics of the evidence (such as size and physical state). However, when there is control on the variation of physical properties in materials of the same kind, the discrimination potential of the methods used to measure such properties decreases. In many of those cases, elemental analysis has demonstrated to have a great value when used for the characterisation of such materials. In addition, if the sample is small, more sensitive methods are needed to measure reliably the elemental composition, in particular at trace levels. In recent years, different research laboratories and international networks have made an effort to develop and validate analytical methods with better sensitivity, precision and reproducibility.

At the Netherlands Forensic Institute, different analytical methods have been optimised and validated for the elemental analysis of materials of forensic interest by LA-ICP-MS. Two of these materials, glass and pigment-based ink on paper, have been selected for this presentation. There are many studies demonstrating the value of elemental analysis of glass by different techniques. On the other hand, the need for non-traditional methods for the examination of documents produced with inkjet printers (e.g., threatening letters, contracts, and invoices) has increased only recently with the shifting from dye-based inks to pigment-based inks. Inks belonging to the latter type, are more robust when exposed to light and more resistant to solvents in contact with the paper, thus, not bleeding as much as inks of the former type. However, pigment-based inks are not soluble and therefore, not easily separated by traditional methods such as TLC and HPLC. The improved quality in the manufacturing of printers makes the differentiation among them based on physical characteristics more difficult, whether from the same manufacturer or from different ones.

The technique, LA-ICP-MS, combines the sensitivity and precision of ICP-MS with the advantages of laser ablation sampling. With the use of LA-ICP-MS there is no need for laborious and lengthy digestion procedures with dangerous chemicals. In addition, the common analytical interferences that are increased by the presence of solvents are minimised using laser sampling, improving the detection limits of some potentially discriminating elements. The amount of material ablated for the complete analysis is very small (~fg), allowing the analysis (including replicates) of very small samples. The destruction is minimal with craters in the order of 10^{-8} m^2, in contrast to the solution approach where the whole sample to be analysed is irreversibly digested. The system at the NFI is an ICP-MS (Perkin Elmer ELAN DRC plus) in combination with a 3 mJ213 nm-laser ablation system (New Wave UP-213).

The standard reference materials (SRMs) NIST 612 and 1830 were used for the development and validation of a quantitative method for glass analysis. This method has been used to analyse glass samples collected by the police from different locations within the Netherlands. In addition, the traditional analyses such as the refractive index measurements and the less sensitive semi-quantitative µXRF measurements were carried out on all the samples. The methods, the selection of the matching criteria and the results of the comparisons of the samples using elemental concentrations and refractive index (measured with GRIM II) will be discussed. Finally, the development and validation and application of a semi quantitative method for the analysis of pigment-based inkjet inks will be also discussed.

LA-ICP-MS, Elemental Analysis, Trace

 ** Presenting Author*