B62 A Quantitative Analysis of Trace Elements in Electrical Tapes

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Learning Overview: After attending this presentation, attendees will understand the development and optimization of a new quantitative method of analysis of the elements present in electrical tapes.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing a method for the quantitative analysis of the elements present in plastics, specifically in electrical tapes, which can help in creating and populating databases which can lead to the use of likelihood ratios and the development of standard methods of analysis and interpretation for tape evidence.

Electrical tapes are a common and potentially important form of forensic evidence. Tapes are used for improvised explosive devices, drug packaging, illicit electrical work, and other criminal activities. For the first time, this work reports a quantitative method of analysis for the elements present in electrical tapes. In this quantitative method, a constant stream of standard solution of a mixture of elements is introduced into a spray chamber, where it is mixed with the particles resulting from the laser ablation process of a solid sample. Measurement of the solid particles' mass is achieved using a piezoelectric dust monitor (Kanomax, 3521). The solution and ablation mixture are then introduced into an inductively coupled plasma mass spectrometer (ICP-MS) where an intensity vs. time signal can be obtained for each isotope.[1,2]

By using a solid of known concentrations, a response factor specific to each isotope can be found and the concentrations of the elements present in an unknown solid can be calculated. Solid standards samples used for this method included: NIST SRM-610 and NIST SRM-612 glass standards and BCR-680 and ERM®-EC681m polyethylene standards.

This poster reports the theoretical principles, development, and optimization of a quantitative method of analysis of the elements presents in tapes. Laser optimization and the selection of the optimum solution concentration for the different standards are also reported.

The accuracy of the method was tested using the different solid glass and plastic standards. The bias for the NIST SRM-610 glass standard was found to be below 10% for most of the elements under study; the bias for the BCR-680 polyethylene plastic using ERM®-EC681m polyethylene plastic resulted in less than 10% for most elements under study. Tape concentrations were measured using ERM®-EC681m polyethylene as a known standard and were found to be: 4 ± 1 ppm for As, 2104 ± 318 ppm for Cd, 39 ± 6 ppm for Cr, 5 ± 1 ppm for Pb, 37 ± 5 ppm for Sb, and 1796 ± 270 ppm for Zn. This quantitative method can help in creating and populating databases which can lead to the use of likelihood ratios and the development of standard methods of analysis and interpretation for tape evidence. This method also has the potential to be used for different types of solids without the need to conduct acid digestions and intense sample preparation procedures.[3-5]

Reference(s):

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Quantitative Method, Electrical Tape, LA-ICP/MS