B137 Fiber Sampling Effects on the Detection of Fluorinated Coatings Studied by Pyrolysis-Gas Chromatography-Plasma-Assisted Reaction Chemical Ionization-Mass Spectrometry (Py-GC-PARCI-MS)

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Learning Overview: The goal of this presentation is to provide information on the suitability of fluorinated fiber coatings for fiber classification.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by informing attendees about the potential of fluorinated oil/water-repellant fiber coatings as differentiating characteristics for otherwise identical fibers.

Introduction: The value of fiber evidence is largely dependent upon commonality of fiber characteristics. Therefore, it is essential to utilize any differences possible, including fiber type, color, and chemical additives, to differentiate fibers. Fluorinated polymer coatings are a common chemical additive used to impart oil and water repellence for clothing. Previous work recently demonstrated that there are several classes of these chemicals that can be detected and distinguished using py-GC-PARCI-MS at a single fiber level.[1] In order to be useful in forensic analysis, it is necessary to also understand the variability and persistence of these coatings within sample collection. This work aims to address some of these forensically relevant questions.

Methods: Threads were pulled from commercial clothing items and single fibers were separated from the threads using tweezers. A single fiber was then transferred into a quartz tube for in-line pyrolysis. The pyrolysis products were separated by GC and fluorinated species were selectively converted to F^- by the PARCI ion source for detection by a single quadrupole MS. Pyrograms were then compared pairwise by plotting the intensity of the peaks from one pyrogram vs. the intensity of the peaks from the other pyrogram. The correlation coefficients in the pairwise comparisons served as a similarity metric for the fibers.

Results: To examine location-dependent variability of coatings, a thread from five locations was sampled from two commercially coated clothing articles. The threads were analyzed in triplicate by testing three fibers from each thread. The fibers from various locations were examined for visual differences. Fibers analyzed from a multicolor shirt of uniform fiber type showed similar pyrograms, indicating that neither color nor sampling location had an impact on the detection of fiber coatings. Further, visually similar fibers from the second clothing item also supported the insensitivity of pyrograms to sampling location. However, for fibers from different locations that were also visually different, such as natural vs. synthetic fiber, differences in relative ratios of the pyrolysis products were observed. To further substantiate the utility of py-GC-PARCI-MS, this work will examine the persistence of fluorinated coatings in two experiments. First, determining whether contact between two clothing items can cause the coating to transfer from or to a fiber will be examined. Second, determining the effect of tape lifting, a common fiber collection technique, on the detection of fluorinated fiber coatings will be investigated.

Conclusion: This study has shown that the variability related to location in two different commercially coated clothing has minimal impact on fiber comparisons as long as only visually identical fibers are compared. Additional experiments are aimed at examining coating transfer between fibers and the potential impact of using tape lifts on fiber pyrograms. This information is critical in evaluating the potential forensic value of fiber coatings.

Reference(s):

1. Dolan, Michael J., Robert D. Blackledge, and Kaveh Jorabchi. 2019. Classifying Single Fibers Based on Fluorinated Surface Treatments. *Analytical and Bioanalytical Chemistry* 411, no. 19 (July 2019): 4775–84. https://doi.org/10.1007/s00216-019-01596-6.

Fibers, Coatings, Sampling

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