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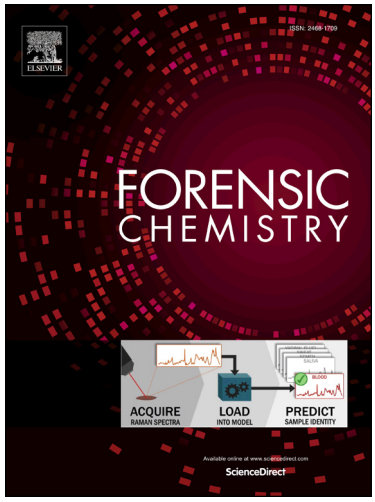

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Forensic Identification of Urine on Cotton and Polyester Fabric with a Hand-held Raman Spectrometer

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Abstract

On-site detection and identification of body fluid samples at crime scenes and in prisons is critical to law enforcement. Current forensic tests for body fluids are highly specific, destructive to potential DNA evidence and time-consuming. Raman spectroscopy (RS) is a label-free, non-invasive and non-destructive analytical technique that provides information about molecular vibrations and consequently chemical structure of the analyzed specimen. These advantages make RS highly attractive for forensic applications. This study demonstrates how RS can be used for confirmatory, non-invasive and non-destructive detection and identification of urine directly on fabrics. This is very important because there have been cases of correctional officers subjected to urine from prisoners. One would envision that conclusive evidence other than eyewitness testimonies will help in potential prosecution of such cases, especially, if both urine and DNA can be simultaneously detected. In this study, we show that using a handheld Raman spectrometer we can detect and identify urine in liquid samples, both on cotton and synthetic fabric, as well as on sweat-contaminated clothes. We also demonstrate that RS is capable of detection and identification of urine directly on police uniform. Finally, we show that coupling of partial least squares discriminant analysis with RS allows for high accuracy prediction of urine on all studied types of fabric.

Key words: Raman spectroscopy, handheld Raman spectrometer, urine detection, law enforcement.

1. Introduction

Forensic investigations typically involve detection and identification of body fluids at a crime scene [1]. The most commonly found body fluid evidence at crime scenes are blood, semen, vaginal fluid, sweat, and urine [2]. Currently available tests for their confirmation are often destructive, which is undesirable due to the high importance of DNA that may be present in the sample [3]. Body fluid analysis is also highly specific, which requires utilization of different forensic methods for each body fluid confirmation. This significantly increases the required time and costs for detailed analysis of a crime scene where several body fluids are simultaneously