



B172 TLC-SERS of Controlled Substances: Colloid Optimization and Drug Expansion

*Marisia A. Fikiet, BS**, 300 Boston Post Road, West Haven, CT 06516; *Kasey R. Cargill, 300 Boston Post Road, West Haven, CT 06516;* and *Brooke W. Kamrath, PhD, University of New Haven, Forensic Science Dept, 300 Boston Post Road, West Haven, CT 06516*

After attending this presentation, attendees will understand the emerging hyphenated Thin-Layer Chromatography with Surface-Enhanced Raman Spectroscopy (TLC-SERS) technique and how it can be used to identify drug mixtures.

This presentation will impact the forensic science community by expanding the use of TLC-SERS for the analysis of controlled substances.

The purpose of this research was to expand previous research on the identification of controlled substances using TLC-SERS. TLC-SERS is a hyphenated technique where a mixture is first separated using TLC followed by SERS of the TLC plate. A noble metal colloid is deposited on the resultant TLC spot and SERS spectra are directly collected. This combined technique has the potential to benefit the forensic science community because it requires less sample, time, and money when compared to other methods of analysis. In addition, it adheres to the standards for positive drug identification established by the Scientific Working Group for the Analysis of Seized Drugs (SWGDRUG).

The first goal of this research was to find a colloid that provided the most enhancement of the Raman signal for various controlled substances. Cocaine, methamphetamine, diazepam, and codeine as 4mg/ml solutions in methanol were used to evaluate the various colloid preparations. A number of both silver and gold colloids were tested and evaluated. Individually, the drugs were drawn up the TLC plate using a mobile phase of 9:1 chloroform:methanol. The plates were allowed to dry, then 20 μ l of the desired colloid was added. The resulting spectra were evaluated on uniformity across sampling, peak height, shelf life of colloid, ease of preparation, and cost of starting materials. The results of this investigation determined that silver colloids worked better than gold colloids. The best colloid was a preparation of a silver colloid first made by White and Hjortkjaer that has the largest SERS enhancement, has a long shelf life, is reproducible, and easy and fast to produce.¹ This silver colloid can be prepared in only a few minutes and has a reported shelf life of more than a year. The second goal of this research was to expand the number and types of controlled substances that can be identified using TLC-SERS. In addition, lower limits of detection were established for each drug. The controlled substances selected for inclusion in this part of the project were determined to be heavily used or on the rise by the 2012 United Nations Office on Drugs and Crime (UNODC) World Drug Report.² The drugs analyzed included heroin, methadone, morphine, codeine, fentanyl, buprenorphine, desomorphine diazepam, GHB, flunitrazepam, phenobarbital, temazepam, methamphetamine, amphetamine, cocaine, mephedrone, MDPV, MDMA, and ketamine. Methanol solutions of each drug, along with drug mixtures, were made and spotted on TLC plates. Following separation, 20 μ l of the optimized colloid were added to each TLC spot and SERS spectra were collected and analyzed.

TLC-SERS spectra are reproducible and interpretable, thus this research demonstrated that TLC-SERS is a successful method for the separation and identification of a wide range of drugs and drug mixtures. Coupling TLC with SERS is a convenient way to reduce the amount of material, equipment, and time needed for controlled substance analysis when compared to current methods and conforms to the standards set forth by SWGDRUG. This is a potentially valuable on-site technique since TLC is a relatively quick and easy technique and the Raman technology has recently become portable. The added sensitivity of the SERS allows for the possibility of very small sample size.

References:

1. International Patent Application PCT/GB2008/004225 (filing date Dec. 20, 2008) (University of Lincoln, P.C. White & J.H. Hjortkjaer, applicants).
2. United Nations Office on Drugs and Crime (UNODC), *World Drug Report 2012* (United Nations publication, Sales No. E.12.XI.1).

Controlled Substances, TLC-SERS, Colloids