A155 Application of Surface Enhanced Raman Spectroscopy to the Forensic Analysis of Blood

Samantha J. Boyd, BS, Virginia Commonwealth University, Department of Forensic Science, 1020 West Main Street, Richmond, VA 23284-3079; Dexian Ye, PhD, and Massimo F. Bertino, PhD, Virginia Commonwealth University, Department of Physics, 701 West Grace Street, Richmond, VA 23284-3079; and Sarah J. Seashols, MS, Virginia Commonwealth University, Department of Forensic Science, PO Box 843079, Richmond, VA 23284-3079*

After attending this presentation, attendees will understand the current applications of surface enhanced Raman spectroscopy (SERS) to the forensic analysis of body fluids, specifically blood. This will include the dissemination of the results of the research conducted, as well as an explanation of the mechanisms behind SERS theory and relevant literature review concerning the utilization of SERS.

This presentation will impact the forensic science community by highlighting the benefits of surface enhanced Raman spectroscopy to the forensic analysis of blood through the comparison of techniques commonly used at crime scenes and in forensic laboratories.

Raman spectroscopy is in the defining stages of determination of application in the forensic arena for the identification of unknown materials. Already it has been used to identify various samples, including automotive paint, condom lubricants, gel pen ink, and contraband drugs. Its potential has been recently extended to the analysis of body fluids. Studies have shown that it is possible to achieve a Raman signature of blood that is characteristic of, and unique to blood, even between people. That, in addition to the advent of the handheld Raman spectrometer, makes this instrument an attractive tool for on-scene confirmatory analysis of physical evidence.

Previously, the dilution limitation detection of blood with the Raman spectrometer was investigated and found to be approximately 1:250, using an excitation power of 2mW at the sample plane. This was comparable to presumptive tests for blood performed on scene with swabs, but not comparable to detection limits of luminol and fluorescein. Analysis of blood samples using SERS and Raman Spectroscopy was investigated and was shown to greatly enhance signals coming from samples. The results of the research have demonstrated a SERS tip (nickel rods on a silicon plate, dusted with silver) allows for a new dilution limit of detection of approximately 1:100,000.

In addition to investigating the limit of blood detection with SERS, dried blood was also reconstituted from fabrics and tested using SERS. Blood was swabbed from fabrics and then rubbed on the SERS tips. Reconstituted blood was found to show signal enhancement; however, no appreciable enhancement seen from the swabs rubbed against the SERS tips. Finally, various plant and chemical material known to give false positives during presumptive tests were examined using Raman spectroscopy. The Raman signatures produced were compared to the Raman signature of blood. Distinct spectra for all tested material were produced, showing Raman spectroscopy has the potential to be used as a confirmatory analysis tool.

In conclusion, SERS can be applied to the forensic analysis of blood, both from blood dilutions and reconstituted blood. Swabs of blood can be analyzed using a Raman spectrometer, but as of yet, no significant enhancement has been achieved using the swabs and SERS. Since Raman spectroscopy produces Raman signatures based on the chemical bonds present in the material tested, unique spectra are produced, leading to the possibility that this instrument may be used as a confirmatory analysis tool.

Raman Spectroscopy, Blood, SERS

 ** Presenting Author*