B56 Probing Potential Interferences in DNA Extraction of Semen Collected on Surface-Enhanced Raman Spectroscopy (SERS) -Active Forensic Evidence Swabs

Katarina G. Ruehl, WCU, 90 Merlite Court, Cullowhee, NC 28723; Brittania J. Bintz, MSc*, 111 Memorial Drive, NSB 231, Cullowhee, NC 28723; Geraldine Monjardez, PhD, Western Carolina University, 327 Natural Sciences Bldg, 111 Memorial Drive, Cullowhee, NC 28723; and David D. Evanoff, Jr., PhD*, Western Carolina University, 231 Natural Sciences Bldg, 111 Memorial Drive, Cullowhee, NC 28723*

After attending this presentation, attendees will better understand the effects of synthesis reaction temperatures on silver characterization of SERS-active forensic evidence swabs. Attendees will also know how the fabrication of the swabs relates to the silver recovered in the extraction solution.

This presentation will impact the forensic science community by introducing a method using silver-coated forensic evidence swabs to successfully identify semen and subsequently extract and genotype DNA, following the insertion of a centrifuge step in the extraction protocol. The following technique has advantages over current approaches because it is sensitive, time efficient, and non-destructive. This could result in the potential identification of a variety of human bodily fluids to be used for DNA analysis.

SERS-active forensic evidence swabs are coated in silver to achieve a technique known as SERS. SERS was developed because Raman spectroscopy is an unfavorable occurrence that can be amplified by placing a metal extremely close to the sample. It was chosen for this research because of its distinctive ability to outline specific biological molecules and do so with minute amounts of sample. This technique would allow for a more convenient method to identify human bodily fluids in the forensic field.

Plain nylon swabs were placed in a synthesis reaction with silver oxide and hydrogen gas via the hydrogen reduction method.[1] This reaction produces silver nanoparticles that grow on the individual fibers of the swabs, thus making them silver-coated. A $[Ru(bpy)_3]^{+2}$ solution was swabbed and used to measure the Raman signal because of its easily identifiable Raman spectrum.

A trial was performed to see how the variation of reaction temperatures affected the efficiency of the swabs. $[Ru(bpy)_3]^{+2}$ solution was swabbed using five swabs of each temperature, which were dried to be tested with a Horiba LabRAM HR Raman microscope. All five data sets were averaged for each swab temperature and compared to observe the best signal. This procedure was similarly used for swabs containing seminal fluid samples. Atomic absorption spectroscopy was also used to obtain the quantity of silver on the swabs before the extraction process. Dissolving the swabs in nitric acid and filtering the solution extracted the silver present on the coated swabs. The solutions were then measured with a Perkin Elmer® Atomic Absorption spectrometer.

To ensure that measureable DNA could be recovered from the silver swabs, an extraction protocol was performed. The DNA recovery results showed no interference with silver nanoparticles, although there was a sizeable amount left in solution during extraction. To resolve a potential issue with silver leaching into the buffer solution, a centrifuge step was added to remove the nanoparticles from suspension, hence allowing for the extraction of the silver-free supernatant. An Applied Biosystems™ PrepFiler™ Forensic DNA Extraction Kit was used on plain silver-coated swabs to obtain solutions just before and after the centrifuge step. To show that the silver was not interfering with results, Inductively Coupled Plasma/Optical Emission Spectroscopy (ICP/OES) was performed on both buffer solutions. Electron microscopy imaging was also conducted on the post-extraction swabs to better characterize how the silver left on the swabs was changing. Data analysis was conducted to determine if a correlation was present between the reaction temperatures and the efficacy of the swabs.

References(s):

1. David D. Evanoff and George Chumanov. Size-controlled synthesis of nanoparticles. 1. "Silver-only" Aqueous Suspensions via Hydrogen Reduction. *J Phys Chem B.* 37 (2004): 13948-13956.

SERS, Semen, Silver Nanoparticles