A162 Preparation and Evaluation of Nanoparticles for Latent Fingerprint Recovery

Patrick D. Bevins, Metropolitan State College of Denver, 1780 South Marion Street, Denver, CO 80218; and Kelly M. Elkins, PhD*, Metropolitan State College of Denver, Chemistry Department & Criminalistics Program, PO Box 173362, CB 52, Denver, CO 80217*

After attending this presentation, attendees will learn how nanoparticles can be used for improving fingerprint development and visualization.

This presentation will impact the forensic science community by demonstrating the synthesis and use of nanoparticles for recovering and developing latent prints.

The identification of individuals using skin ridge patterns dates back almost 4,000 years and was first suggested for forensic use in the 19th century. Fingerprint identification remains a cornerstone of the forensic community. Recently, the literature has demonstrated that nanoparticles improve the developing and recovering of increasingly obscure latent fingerprints including enhancing currently used methods including the silver developer reagent and fluorescence detection. Nanoparticles are materials with dimensions less than 100 nm. Nanoparticles have unique absorbance and other properties as compared to the bulk material due to their small size. Applying nanoparticles to fingerprints begins with the successful creation of the nanoparticles; having control over the size,

shape, and composition is crucial to successful functionality of any nanoparticle. This goal of this presentation is to present the synthesis and application of multiple nanoparticle preparations including gold, cadmium sulfide, and iron oxide (magnetite) nanoparticles in recovering latent fingerprints from a variety of materials. The presence of nanoparticles, as opposed to bulk material, was confirmed using color, UV-Vis spectroscopy, and scanning electron microscopy. The magnetite produced very fine dark colored particles which showed magnetic properties, as expected. The CdS solution turned pale yellow which indicated nanoparticle formation as cadmium sulfide precipitate produces an orange solution. The gold nanoparticle synthesis produced a deep red translucent solution. Varying the gold methods produced thick, opaque precipitates or no color change in the solution; both outcomes were strong indications that nanoparticles were not produced. Soaking a fingerprint in gold nanoparticles has been shown to increase the resolution and contrast of the silver developer. The silver developer is typically a "last resort" method due to its tendency to destroy the sample material. The silver developer works by reducing cationic silver (+1) to elemental silver (0) using a ferrous/ferric redox system and is often used with ninhydrin on porous surfaces such as paper and wood. The results of developing the fingerprints with the nanoparticles were compared those collected with traditional fingerprint dusting powders on a variety of porous simulated forensic surfaces including wood, paper, aluminum can, glass, and white cotton fabric. The nanoparticle production methods should hold broad appeal due to the ease of synthesis using very dilute solutions.

Nanoparticle-protein bioconjugates were also evaluated for applications in fingerprint detection and the detection of "lifestyle intelligence" or drugs or secondary metabolites found in fingerprints or other body fluids by attaching drug- or metabolite-specific antibodies. The antibody fluoresces if attached to the target metabolite, providing the ability to detect the drug and photograph the fingerprint under ultraviolet light. The fingerprint can also be developed with the silver developer solution. Testing fingerprints for drug metabolites shows promise in a variety of forensic applications including narrowing a list of suspects based on drug use, or in workplace or roadside drug testing. Drug or drug metabolite testing on fingerprints provides a unique identification method of the individual being tested, removing the possibility of samples being mixed. Initial experiments were performed using bovine serum albumin and ATR FT-IR and fluorescence analysis.

Fingerprinting, Nanoparticles, Drug Testing