B162 Improving Multimetal Deposition (MMD) as a Fingermark Detection Technique Through the Functionalization of Gold Particles

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After attending this presentation, attendees will learn about the different possibilities in improving multimetal deposition (MMD) by functionalization of gold particles. They will be able to go back to their laboratory and put in direct practice these new formulas of MMD to detect fingermarks.

This presentation will impact the forensic community and/or humanity by demonstrating a second birth of multimetal deposition (MMD), which will greatly improve the contrast obtained with this enhancement technique. This leads to a better detection of fingermarks on both porous and nonporous surfaces. This could have a tremendous impact in a case involving the detection and enhancement of fingermarks.

Since its invention by Saunders in 1989, multimetal deposition (MMD) has been the subject of very little research. In 1999, Schnetz and Margot published a new formulation that led to improved fingermark enhancement and more consistent results. Since that day, no other improvement has been presented for MMD.

MMD is a very sensitive fingermark enhancement technique that has the great advantage to work on both porous and nonporous surfaces. Additionally, it leads to very detailed ridge impressions. It has the main inconvenience of being very labor intensive and requires the use of bidistilled water and siliconized glassware. The preparation of the solutions is long and tedious and the development procedure also requires intense labor. All this work would be worth it if the results were undeniably better than all other enhancement techniques. However, this is not the case. Gold colloids deposition must be followed by the application of a modified physical developer (silver particles) to obtain grey to black fingermarks. While this technique works great on many light-colored or transparent surfaces, the resulting contrast does not suffice to properly observe fingermarks on many patterned backgrounds.

In the last few years, new perspectives in the use of MMD have been proposed, researched, and developed in this laboratory. The strategy is based on the functionalization of the gold nanoparticles, either in solution or already deposited on the fingermark, to build a molecular structure containing dyes or fluorophores. The relatively easy modification of gold nanoparticles opens the road to various different molecular structures offering their own capabilities. The ultimate aim is to significantly increase the contrast of the enhanced fingermarks.

In a first approach, gold nanoparticles were functionalized with cyclodextrins (CDs). CDs are cyclic oligosaccharides that have a truncated cone shape. They make great molecular hosts for organic molecules in aqueous solution. The native structure of the CDs was modified to include a thiol group that presents a very high affinity for gold. The 6-monodeoxy-6-monothio b-cyclodextrin was used to create self-assembled monolayers (SAMs) on gold. The dye Acid Blue 25 was used to enhance the print.

In a second approach, gold nanoparticles were used as docking sites for proteins. The idea behind this strategy is to be able to attach a fluorescent marker to the gold particle. Several mechanisms have been tried. Lately, the use of a spacer to ensure a covalent binding between the gold nanoparticle and the protein was attempted. In a first attempt, dithiobis (succinimidyl propionate) was chosen as it allows the building of SAMs on the gold nanoparticles through its thiol group and the binding of macrobiomolecules to its other extremity. Other molecules have been explored.

Other venues regarding the functionalization of the gold and the fluorescent marker have also been thought of and will be presented.

Multimetal deposition as a development technique for fingermarks will be briefly reviewed. The attendees will be presented all the different functionalizations of gold nanoparticles that have been thought of and attempted. The results of the experiments will be presented and the advantages compared to the original formulation will be thoroughly explained. After the presentation, the attendees will have all the necessary information to implement these new formulations in their laboratory.

Fingermark Detection, Nonporous and Porous Surfaces, Fingerprint Deposits

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