B94 Latent Fingermark Detection Using Functional Nanomaterials

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Learning Overview: The goal of the presentation is to provide an outlook on the use of nanoparticles for the detection of latent fingermarks.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating the possibility of engineering nanoparticles for latent fingermark detection and thus achieve success in using them for routine forensic examinations such as fingermark detection.

Nanoparticles (NPs) have been used in several applications like solar cells, drug delivery, LEDs etc. Application for fingermark detection has been explored mainly due to their small size, functionalization of their surface, and luminescence properties. Despite all the research that has been done so far on the use of nanoparticles for fingermark detection, few publications present clear supporting evidence of their superiority over commonly used techniques. The problem is that nanoparticles are often designed for applications outside forensic science and are then tentatively applied onto fingermarks with limited success.

Significant research has been conducted on nanoparticles for fingermark detection applications as a novel approach that promises increased sensitivity and selectivity. Different kinds of nanopowders such as gold, silver, titanium dioxide, and aluminum oxide have been applied instead of conventional fingerprint powder for fingermark detection.[1] Multimetal deposition (MMD) using silver and gold nanoparticles has been investigated for its application on various surfaces–porous and nonporous, wet and dry, single-metal deposition (SMD)–a simpler alternative to MMD–involving gold enhancement of the deposited gold nanoparticles.[2,3] Different metal oxides including titanium dioxide, aluminum oxide, or zinc oxide often functionalized with aliphatic chains have been reported. Cadmium telluride (CdTe) quantum dots (QDs) have been studied for the detection of weak fingermarks in blood on non-porous surfaces.[4]

No nanoparticle-based approach applied to-date has demonstrated all three advantages (size, functionalization, and optical properties). Silicon oxide nanoparticles appear to be the best candidate to address this issue. They consist of a porous matrix of siloxane bonds with an external layer of silanol groups that can further react through hydrolysis and condensation with various alkoxysilanes to be linked with functional groups; antibodies or aptamers can be grafted onto the NP's surface to selectively target fingermark components.[5] Luminescent dye molecules can be trapped within the siloxane matrix, which provides extended optical properties to maximize contrast between fingermarks and the background. This study presents various syntheses of silicon oxide (SiO_2) nanoparticles via reverse microemulsion and their subsequent application to detect fingermarks on non-porous substrates. The main goal is to design a technique that is user-friendly, cost-effective, and that can be implemented in routine practice by law enforcement authorities.

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Fingermark, Nanoparticle, Silicon Oxide