B39 Functionalization of Nanocrystals for Latent Fingerprint Development

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After attending this presentation, attendees will have the opportunity to discuss a new method for visualizing latent fingerprint with new nanomaterials which have unique advantages over current dyes. Attendees will be able to understand the chemistry of functionalization of nanomaterials for the purpose of latent fingerprint development

This presentation will impact the forensic community by discussing a sensitive method for latent fingerprint development. The new technique will impact the forensic science community by offering a new way in visualizing trace amount of fingerprint residues or aged fingerprints on porous objects.

The use of ninhydrin reacting with amines (including α-amino acids) in fingerprint residues to give a colored product has long been a method of choice for latent fingerprint development on porous surfaces. However, background interferences and discontinued-ridges of ninhydrin-developed fingerprints often caused problems in the later comparison of fingerprints. Fluorescent ninhydrin derivatives and post- ninhydrin treatment are common alternatives for the improvement of the quality of latent fingerprints. A new development of visualization of latent fingerprints using functional nanocrystals will be proposed. Attendees will be able to understand the functionalization of nano- materials and their chemistry in latent fingerprint development.

Semiconductive nanocrystals, also known as quantum dots (QDs), are nanocrystals with fluorescent properties dependent on the particle size. QDs have been considered as promising replacement over organic fluorophores in order to enhance the limits of detection. Many merits of using QDs, such as incredibly high photostability, wide absorption spectra, high fluorescence signal-to-noise ratio, and wide variety of emission colors make them very attractive in signal enhancement, sensor design and biological applications. With these unique properties of QDs, single bacterial pathogen detection has recently been made possible. The limits of detection can be improved at least 100 times with QDs as compared to the conventional fluorescein isothiocyanate (FITC)- based method. Menzel et al. first utilized QDs for latent fingerprint development. They investigated CdS/dendrimer nanocomposite to target fingerprint lipids or triglycerides. The dendrimer has been used as a bridge to incorporate CdS nanoparticles and to bond the fingerprint residues. Unfortunately, to mediate nanocrystallite/dendrimer composites, diimide pre-treatment of object surface was needed, thus created unwanted cross reactions. Moreover, nanocryallite/dendrimer composites tended to adhere onto every where, not just fingerprint residues. Serious background interference was inevitable. A better strategy is to functionalized QD surface to allow direct attachment onto fingerprint residues with minimum background interference, and promote high contract of fingerprint images.

Generally, strategies of functionalization of QDs have been based on the covalent linkage, electrostatic attraction and biotin–avidin interactions of QD surface ligands with target molecules. The established zero space carbodiimide-mediated coupling reaction (such as N-(3-dimethylaminopropyl)-N'-ethylcarbodiimide (EDC) - N- hydroxysuccinimide (NHS) chemistry) has been proved effective to allow conjugation of amines to water soluble carboxylate QDs. In this work, our strategy was focused on the synthesis of reactive ester on QD surface as the functional QDs to react amines in fingerprint residues. Both water soluble and insoluble species of functional QDs were tested in order to determine the best quality of fingerprint image. Excitation of fluorescence of QDs was achieved by using an alternative forensic light source (CrimeScope, CS-16-500). Comparison of conventional methods with the new technique will be reported and discussed.

Nanocrystals, Latent Fingerprint Development, Fluorescence

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