

Forensic Applications of Quantum Dots

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Abstract : Quantum dots (QDs) are semiconductor nanocrystals that exhibit intrinsic optical and electrical properties that are size dependent due to the quantum confinement effect. Quantum confinement is brought about by the fact that in bulk semiconductor material the electronic structure consists of continuous bands, and that as the size of the semiconductor material decreases its radius becomes less than the Bohr exciton radius (the distance between the electron and electron-hole) and discrete energy levels result. As a result QDs have a broad absorption range and a narrow emission which correlates to the band gap energy (E), and hence QD size. QDs can thus be tuned to give the desired wavelength of fluorescence emission. Due to their unique properties, QDs have attracted considerable attention in different scientific areas. Also, they have been considered for forensic applications in recent years. The ability of QDs to fluoresce up to 20 times brighter than available fluorescent dyes makes them an attractive nanomaterial for enhancing the visualization of latent fingerprints, or poorly developed fingerprints. Furthermore, the potential applications of QDs in the detection of nitroaromatic explosives, such as TNT, based on directive fluorescence quenching of QDs, electron transfer quenching process or fluorescence resonance energy transfer have been paid to attention. DNA analysis is associated tightly with forensic applications in molecular diagnostics. The amount of DNA acquired at a criminal site is inherently limited. This limited amount of human DNA has to be quantified accurately after the process of DNA extraction. Accordingly, highly sensitive detection of human genomic DNA is an essential issue for forensic study. QDs have also a variety of advantages as an emission probe in forensic DNA quantification.

Keywords : forensic science, quantum dots, DNA typing, explosive sensor, fingerprint analysis

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