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Application of SERS with Raman reporter-labelled metallic nanoparticles for latent fingermark enhancement

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The importance of human fingermark identification and individualization for forensic purposes cannot be overemphasized. Novel approaches have recently been adopted to understand the chemistry of latent fingermarks and produce reagents targeting some of these constituents of latent fingermarks. Nanotechnology and surface-enhanced Raman spectroscopy (SERS) are increasingly being studied for application in latent fingermark enhancement and chemical imaging. In this study, SERS was used to investigate the applicability of Raman reporter-labeled metallic nanoparticles to enhancement of latent fingermarks. Rhodamine 6G and 4-mercaptobenzoic acid were investigated as Raman reporters adsorbed on either gold or silver nanoparticles. Functionalized nanoparticles were deposited onto latent fingermark samples and characteristic Raman vibrational bands of reporter molecules, when adsorbed on nanoparticles (1076 cm^{-1} and 1583 cm^{-1} for 4-mercptobenzoic acid; 610 cm^{-1}, 1360 cm^{-1}, 1505 cm^{-1} and 1648 cm^{-1} for rhodamine 6G) were monitored and showed very low variability of peak position between samples (coefficient of variation generally <0.5%). Adsorption of reporter molecules on nanoparticles was characterized using UV-vis absorption spectroscopy as well as the behaviour of characteristic Raman shifts of the molecules which indicated successful adsorption. Rhodamine 6G in this study however had a weak adsorption onto silver nanoparticles as a result of suboptimal amounts of dye molecule. Preferential deposition of the Raman reporter-labeled nanoparticles on fingermark ridges was observed with fingermarks deposited on non-porous surface. This study demonstrates the potential for SERS chemical imaging of latent fingermarks based on characteristic SERS vibrational bands from reporter molecules adsorbed on metallic nanoparticles and deposited onto latent fingermarks.

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