Surface-enhanced raman scattering technique for polycyclic aromatic hydrocarbons detection using thiol-functionalized silver nanoparticle films

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Abstract: Surface-enhanced Raman scattering (SERS) is widely used to detect trace analytes by using metal nanoparticles with plasmonic oscillation as a substrate where the analytes are adsorbed and affected by the enhanced electromagnetic field results in the enhancement of Raman intensity. Although metal nanoparticle colloid can promote high Raman intensity, they are unstable and inconvenient to use. Metal nanoparticle film is another way to create SERS substrate that is stable, portable, and easy to use. In this study, we use silver nanoparticle film fabricated by Langmuir-Blodgett method as a SERS substrate to detect polycyclic aromatic hydrocarbons (PAHs). In order to detect PAHs by SERS, the adsorption of PAHs on the silver nanoparticle film is required. Therefore, the surface of silver nanoparticle film is functionalized with various types of thiols (aromatics and aliphatics) to create a hydrophobic layer for trapping PAHs. The fabricated films are stable as they can be kept, for at least, 1 month before using as a substrate. The results indicate that chrysene, pentacene, pyrene, perylene, and triphenylene can penetrate into the surface of functionalized silver nanoparticle film as Raman spectra show their own characteristic peaks and can be detected with a limit of detection reaching to $10^{-6}$ M.

Keywords: Surface-enhanced Raman scattering (SERS); Polycyclic aromatic hydrocarbons (PAHs); Silver nanoparticles (AgNPs); Langmuir-Blodgett (LB); Film