

Au nanoparticles grafted on Fe₃O₄ as effective SERS substrates for label-free detection of the 16 EPA priority polycyclic aromatic hydrocarbons

J. DU AND C. JING*

State Key Laboratory of Environmental Chemistry and Ecotoxicology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085, China (*correspondence: cyjing@rcees.ac.cn)

Several methods and materials have been explored for the sensitive and practicable detection of polycyclic aromatic hydrocarbons (PAHs). However, it is still a challenge to develop simple and cost-effective sensing techniques for PAHs [1,2]. The present work has proposed a facile method for SERS sensing of the EPA 16 priority PAHs. Herein we report the synthesis and construction of Fe₃O₄@Au SERS substrate. This magnetic substrate was composed by Fe₃O₄ microspheres and Au NPs. The size, morphology, and surface composition of Fe₃O₄@Au were characterized by multiple complimentary techniques including scanning electron microscopy, X-ray photoelectron spectroscopy, and X-ray powder diffraction. The spatial distributions of electro-magnetic field enhancement around Fe₃O₄@Au was calculated using finite difference time domain (FDTD) simulations. As a result of its remarkable sensitivity, the Fe₃O₄@Au-based SERS assay has been applied to detect the 16 EPA priority PAHs. The LODs achieved by our method (100~5 nM, 16.6~1.01 µg L⁻¹) make it promising for the rapid screening of highly contaminated cases. As a proof-of-concept study, the substrate was applied in SERS sensing of PAHs in river matrix. The 16 PAHs could be differentiated based upon their characteristic SERS peaks. Most importantly, the detection was successfully conducted using a portable Raman spectrometer, which could be used for on-site monitoring of PAHs. The present approach does not require expensive instrumentation or large sample volumes. The quick and cost-effective protocol is expected to be particularly useful for the identification of hydrophobic molecules with similar chemical structures, for which effective separation protocols may be difficult to develop.

[1] J. Du, C. Jing,. (2011) *J. Phys. Chem. C*. **115**, 17829-17835. [2] J. Xu *et al.* (2014), *Acs Appl. Mater. Interface*. **6**, 6891-6897.