
Noble Metal Nanostructures Based Surface-enhanced Raman Scattering Fiber Probe for Trace Molecular Detection

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Abstract

The detection performance of SERS fiber probes is highly determined by the geometries, morphologies, and components of noble metal nanostructures. In this research, different Ag, Au and alloy nanostructures were synthesized through chemical reduction method. The nanostructures were homogeneously coated on glass fiber end-tip for SERS fiber fabrication. The compositions, shapes, and sizes distributions of nanostructures were analyzed by XRD, TEM, and EDS. The stronger and larger areas of LSPR induced electromagnetic field from nanorod dimer and carbon dots decorated Ag nanoparticles implied better SERS behaviour. The lowest detection limit can reach 10⁻¹¹ M for Au/Ag alloy nanorod fiber probes (Fig. 1 a), and 10⁻⁹ M for carbon dots decorated Ag nanoparticles fiber probes, using CV or R6G as an analyte. The relationship between Raman intensities and analyte concentrations showed well linear, for quantitative analysis, and the fiber probes showed excellent reproducibility and stability. Furthermore, carbon dots decorated Ag nanoparticles fiber probes were applied for trace Hg²⁺ ions detection, ranging from 10⁻⁵ to 10⁻¹¹ M (Fig. 1b), from carbon dots reduced Hg meta surface wrapping on Ag nanoparticle surface, which decreased Raman intensities from CV analyte. The fiber probes can be applied for low-content chemical, biological molecules, and other detection.

Keywords: Surface, enhanced Raman scattering, Noble metal nanoparticles, Optical fiber, LSPR

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