PÔSTER - RESUMO - SENSORES E BIOSSENSORES

SPECTROELECTROCHEMICAL INVESTIGATION OF GOLD NANOPARTICLE PLATFORMS

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The fundamental relationship between surface chemistry, nanostructured interfaces, and analytical performance in electrochemical surface-enhanced

Raman spectroscopy (EC-SERS). The efficiency of EC-SERS using nanostructured carbon materials is largely dictated by surface-related chemical features. Fine control over the interfacial environment allows regulation of molecular binding events and electron-transfer processes at the surface, which directly impact analytical sensitivity and measurement reliability. Here, we examine approaches for tailoring the surface chemistry of carbon nanostructures decorated with gold nanoparticles to improve their behavior in electrochemical SERS system. The present study emphasizes that the efficiency of EC-SERS systems based on nanostructured carbon materials is predominantly governed by surface-related chemical properties. In particular, the interfacial environment between the carbon substrate, the gold nanoparticles with different sizes and morphologies (nanospheres or nanotriangles)[1], and the target analyte plays a decisive role in controlling adsorption behavior and interfacial electron-transfer dynamics. By integrating spectroscopic and electrochemical approaches, the investigation provides insight into how engineered carbon platforms decorated with gold nanoparticles can be optimized for enhanced Raman signal amplification of 4-nitrothiophenol. Fine tuning of surface functionalities enables modulation of molecular binding strength and orientation, which are critical parameters for achieving reproducible and highly sensitive SERS responses. Moreover, the presence of gold nanoparticles introduces localized surface plasmon resonance (LSPR) effects, intensifying the electromagnetic field at the interface and promoting charge-transfer interactions that further enhance Raman scattering signals. The study examines strategies to tailor the chemical environment of carbon nanostructures prior to and after gold nanoparticle deposition. Parameters such as nanoparticle morphology, distribution, and interparticle spacing are considered key determinants of hotspot formation and signal stability. The spectroelectrochemical configuration allows real-time monitoring of redox-active species, enabling correlation between applied potential, molecular transformations, and Raman spectral evolution. Overall, this work establishes a systematic framework for understanding how interfacial engineering influences EC-SERS performance [2]. The insights derived from the spectroelectrochemical investigation contribute to the rational design of advanced nanostructured platforms with improved sensitivity, selectivity, and reproducibility, opening perspectives for applications in chemical sensing, environmental monitoring, and bioelectronic devices.

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