PÔSTER - RESUMO - SENSORES E BIOSSENSORES

TUNING THE SURFACE CHEMISTRY CHARACTERISTICS OF NANOSTRUCTURED CARBON PLATFORMS FOR ELECTROCHEMICAL SERS APPLICATIONS

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The rational control of surface chemistry in nanostructured carbon platforms plays a decisive role in determining their performance in electrochemical surface-enhanced Raman spectroscopy (EC-SERS)[1]. Carbon-based nanostructures have attracted increasing attention in EC-SERS due to their chemical stability, tunable electronic properties, and compatibility with

electrochemical environments. In particular, the chemical composition, density of functional groups, defect distribution, and electronic structure of the carbon surface strongly influence the local electromagnetic environment as well as molecule–surface interactions. These parameters directly affect signal enhancement mechanisms, including both electromagnetic and chemical contributions, which are fundamental to SERS performance. By tailoring the interfacial chemical properties of nanostructured carbon interfaces, it is possible to modulate adsorption, molecular orientation, and charge-transfer processes involving small molecules and biomolecules. Such processes are critical factors for achieving sensitive, selective, and reproducible SERS detection under electrochemical control. Surface functionalization strategies, such as the introduction of oxygen- or nitrogen-containing groups, can alter surface polarity and electronic density, thereby influencing adsorption strength and electron-transfer kinetics. Moreover, controlled surface chemistry enables improved stability of adsorbed species under applied potentials, reducing signal fluctuations during EC-SERS measurements. The ability to precisely tune these interfacial properties is particularly important for applications in bioelectrochemistry and bioelectronics, where complex molecular environments and dynamic redox processes are involved. In this context, nanostructured carbon platforms offer a versatile framework for investigating fundamental surface phenomena while maintaining biocompatibility and electrochemical robustness. Understanding how surface chemistry governs molecule–substrate interactions is essential for the rational design of advanced EC-SERS platforms capable of monitoring biologically relevant processes in real time. In this work, we investigate the tuning of surface chemistry characteristics of nanostructured carbon platforms for electrochemical SERS applications using 4-nitrothiophenol (4-NTP) as a well-defined probe molecule for future application in bioelectrochemistry and bioelectronics[2]. The selection of 4-NTP is motivated by its well-established electrochemical activity, strong Raman signature, and sensitivity to charge-transfer interactions at the electrode interface. As a model system, 4-NTP allows systematic evaluation of surface–molecule interactions, adsorption behavior, and charge-transfer mechanisms under controlled electrochemical conditions. These insights provide a fundamental basis for extending EC-SERS methodologies to more complex biological molecules and functional biointerfaces.

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Palavras-chave: carbon nanostructures interfaces; plasmonic metal nanoparticles; vibrational spectroscopy; sers effect; 4-ntp.