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Integration of bacteria-imprinted polymer with aluminium transducers: Polymeric electrical behaviour to ionic species

Abstract

Background: Confronted with escalating public health issues exacerbated by bacterial infections, introducing a cost-effective and reliable approach for rapid bacteria detection is imperative. Methods: In this research, bacteria-imprinted polymers (BIPs) technology targeting Bacillus subtilis was developed and characterised with Raman Spectroscopy and Fourier Transform Infrared Spectroscopy (FTIR). The BIPs were then incorporated into our newly designed capsula capacitive proximity electrode (CapCPE) sensor. Successful deposition of BIPs was validated by scanning electron microscopy (SEM), while the average thickness of the BIP coating was recorded as ~ 3.0 µm. The current responses of both the bare device and BIP-CapCPE to different pH levels were examined. Significant Findings: The results revealed that the bare device generated a maximum current of 7.55×10^{-4} A in a highly acidic medium. In contrast, the BIP-coated device exhibited a maximum current of 1.0×10^{-4} A in a highly alkaline medium, attributed to increased charge carrier density from the carboxyl group deprotonation in recognition cavities. Moreover, the mechanistic insights into the impact of strong electrolytes on BIP-coated electronic sensors were further proposed and elucidated. Electrochemical impedance spectroscopy (EIS) was additionally employed to reveal the impedimetric and capacitive behaviours of the devices in varied pH media.

Keywords

Electrical transduction; Electrochemical impedance spectroscopy; pH response; Surface functionalisation