Engineering a Novel Electrochemical Biosensor Using a Self-Healing ZnO Quantum Dot Matrix and MIP Technology for Lysozyme Detection

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With implications in diseases such as monocytic leukemia, sarcoidosis, and Alzheimers, the detection of lysozyme, an antimicrobial enzyme, remains central in the development of precise antibiotic treatments, preventative disease diagnoses, natural preservatives, and biotechnology to bolster innate immunity. Although existing biosensors display low detection limits, their precise detection of lysozyme is contingent with the usage of modified nanoparticles, specific aptamers, etc., which present themselves as additional production costs, impacting their pervasiveness in industry. Thus, this study introduced an electrochemical biosensor that uses molecularly imprinted polymer (MIP) technology for the detection of lysozyme, displaying physiologically relevant limits of detection, quantitation, and blank, with significant agarose self-healing capability, while mitigating the production costs to \$0.40 to \$0.50 per sensor. The study progressed to evaluate and optimize, through cyclic voltammetry, the performance of the biosensor architecture: (i) by incorporating ZnO QDs, (ii) by using a poly(vinyl alcohol)-poly(ethylene glycol) matrix , and iii) by conferring agarose gel - based self healing, resulting in an optimized 1% MIP, 5% PVA - 2% PEG, 4% ZnO Qds, and 8% Agarose gel matrix. The architecture of the sensor is versatile, such that it can easily be adapted for other, understudied proteins, through a simple modification - substituting the MIP in the sensor's architecture with the MIP of the target protein itself, providing a precise method of detection during the early studies of understudied proteins.

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