Challenges and Possible Approaches to Molecular Imprinting for Nanobiosensing of Small Molecules

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Abstract

In various applications, from biomedicine to environmental monitoring and nanobiosensing, molecularly-imprinted polymers (MIPs) have shown their potential as customizable synthetic receptors capable of distinguishing large and small molecules with high molecular specificity. Biorecognition elements, such as antibodies and enzymes, have shown inherent problems with temporal stability and can be denatured under extreme conditions [1]. MIPs, however, are more robust in complex media, have better long-term stability, and a more straightforward and reproducible fabrication procedure. However, there is a scarcity in the literature of papers investigating the quantitative analytical capabilities of MIPs in real-world applications. There are still several factors that must be addressed before MIPs-based biosensors can be commercialized [2,3]. The most critical challenge that needs to be addressed in MIPs development is to study the binding interactions between monomers and between the monomer and the template in a porogenic solvent, which must form a spontaneous and stable template-monomer complex. In this project, we study the ionic form of kynurenic acid, as a model small molecule template, in several matrices, along with its complexation with o-phenylenediamine. Additionally, further studies encompass an adaptation of the MIP layer onto nanomaterial-based electrodes, due to their ease of tuning and fabrication. MIPs have been shown to possess higher sample loading capacities, sensitivity, and selectivity for small molecules than conventional immunoassays [4,5], which makes them interesting in quantitative small molecule biomarker detection.

References

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