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Materials Innovations for Enhancing the Limit of Detection of Biosensors (I)

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Miniaturized biosensors are essential components of continuous health monitoring systems, which are expected to significantly impact human health management. Biosensors integrate biorecognition elements with transducers to detect the presence, absence, and quantity of biologically-relevant elements. Nanoscale materials play a critical role in enhancing the sensitivity and specificity of these devices.
In this work, we have developed a fabrication toolbox for creating interfaces that combine biorecognition and signal transduction. More specifically, we use multiple tunable materials building blocks to create electrochemical or photoelectrochemical biosensors. A wrinkled scaffold with tunable feature sizes is used to create a high density network of nanoparticles. A biofunctionalized network of semiconductive or metallic nanoparticles is used to create integrated biorecognition/signal transduction interfaces. Furthermore, a network of nanoparticles featuring molecular linkers is used to reduce biofouling and non-specific adsorption in biosensors. By combining the materials strategies developed in this work, we demonstrate multiple biosensor examples for detecting specific nucleic acid sequences and protein targets. Finally, a clinically-relevant biosensor for the detection of Brain Derived Neurotrophic Factor is demonstrated.

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