DNA-Based Biosensors for Protein Detection: Harnessing Structure-Switching and Scaffold Designs

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The accurate detection and monitoring of protein analytes for disease diagnosis and physiological tracking necessitate highly sensitive, specific, user-friendly, and rapid methods. Over the past decade, numerous DNA-based sensing techniques and sensors have been developed to achieve quantitative readouts of protein biomarkers. Inspired by the efficiency, specificity, and versatility of naturally occurring chemosensors reliant on structure-switching biomolecules, extensive endeavors have been made to emulate these mechanisms in artificial biosensor fabrication for protein detection. A promising alternative approach involves scaffold DNA biosensors, wherein diverse recognition elements (e.g., peptides, proteins, small molecules, antibodies) are precisely conjugated to the DNA scaffold to interact specifically with target proteins, exhibiting high affinity and specificity. These biosensors offer various advantages and hold immense potential, particularly in the substantial enhancement of transduction signals. In this presentation, I provide an overview of exemplary structure-switching-based and scaffold DNA sensors, while also introducing to the rational design of innovative sensing mechanisms and strategies based on programmable functional DNA systems for protein detection