Engineering conformational biosensors for personalized medicine applications

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The future of personalized medicine relies on the use of biosensing technologies capable of performing continuous molecular measurements of many important biomarkers, drugs, hormones, and metabolites. These technologies will significantly improve our ability to monitor, diagnose and treat diseases, empowering patients to make informed decisions on their own health[1]. Motivated by this, our goal is to develop sensing technologies capable of performing real-time, continuous measurements, directly in vivo, of many different targets[2].

Inspired by Nature's tools and strategies, we have set out to design new receptors and signaling mechanisms. In particular, we are using computational tools, artificial intelligence, and experimental biophysics to engineer DNA aptamers and nanobodies as conformational receptors, coupling ligand binding to a conformational change that we can use to achieve reagentless signal transduction [3].

As specific applications, we have designed electrochemical aptamer-based sensor for continuous in vivo monitoring of drugs in animal models, which we have used to achieve fully personalized, real time-controlled drug delivery. In addition, we have developed a nanobody-based optical sensor for chorionic gonadotropin, a placental hormone used to monitor pregnancy, and a protein-based electrochemical sensor for monitoring immunosuppressants.

The ability to rationally design conformational receptors generalizable will support the development of new biosensors capable of performing continuous, real-time in vivo measurements of many different analytes, such as drugs, hormones, and biomarkers, enabling the widespread implementation of personalized medicine.

References

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