Real-time, continuous monitoring of clinically relevant molecules via electrochemical aptamer-based sensors

Andrea Idili[1]

[1] University of Rome Tor Vergata, Via della Ricerca Scientifica 1, Rome, Italy

Andrea.Idili@uniroma2.it

Abstract

The development of biosensors able to measure clinically and physiologically relevant molecular targets in-situ in the body could revolutionize health care. Real-time monitoring of drug or metabolite levels in the blood, for example, would support the high-precision measurements of patient-specific pharmacokinetics and, ultimately, even closed-loop feedback-controlled drug delivery. Such personalization of drug dosing would maximize drug efficacy while minimizing side effects. Electrochemical aptamer-based (EAB) sensors can achieve this goal in a modular way, so far supporting the multi-hour in vivo monitoring of several relevant targets without relying on their specific chemical properties [1-3]. The modularity of EAB sensors relies on the use of nucleic acid aptamers as recognition elements, which can be selected to reversibly and selectively bind any kind of molecular target supporting their detection in untreated biological fluids such as whole blood. However, the development of EAB sensors from in vitro settings to relevant in vivo clinical applications displays some technical challenges. This tutorial will describe the general concepts behind the fabrication and the characterization of electrochemical aptamer-based (EAB) sensors, and their next adaptation to achieve real-time measurements of clinically relevant targets directly in living animals.

References

[1] Arroyo-Currás, N., Somerson, J., Vieira, P. A., Ploense, K. L., Kippin, T. E., & Plaxco, K. W. (2017). Real-time measurement of small molecules directly in awake, ambulatory animals. Proceedings of the National Academy of Sciences, 114(4), 645-650.

[2] Idili, A., Arroyo-Currás, N., Ploense, K. L., Csordas, A. T., Kuwahara, M., Kippin, T. E., & Plaxco, K. W. (2019). Seconds-resolved pharmacokinetic measurements of the chemotherapeutic irinotecan in situ in the living body. Chemical science, 10(35), 8164-8170.

[3] Idili, A., Gerson, J., Kippin, T., & Plaxco, K. W. (2021). Seconds-Resolved, In Situ Measurements of Plasma Phenylalanine Disposition Kinetics in Living Rats. Analytical Chemistry, 93(8), 4023-4032.

Figures