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Organic Electrochemical Transistors for Protein Detection

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Conjugated polymers provide a unique toolbox for establishing electrical communication with biological systems. In this talk, I will show how these materials are used in organic electrochemical transistors (OECTs) to detect biological species in physiological media. I will introduce two types of OECT based sensors; one that detects Alzheimer's disease biomarkers with performance exceeding the state-of-the-art,[1,2] and the other that detects coronavirus spike proteins at the physical limit.[3] Having challenged these sensors with patient samples, I will discuss areas where proof-of-concept organic biosensor platforms may fail. By tackling each of these problems, we improve device performance to a level that marks a considerable step toward biochemical sensing of infectious and noninfectious disease biomarkers. I will highlight that the advances in biosensor device design stem from in-depth investigations of the active materials' transport properties, device operation principles and carefully designed biorecognition units.

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[2] A. Koklu, S. Wustoni, V. Musteata, D. Ohayon, M. Moser, I. McCulloch, S. Nunes, S. Inal, "A Microfluidic Integrated Organic Electrochemical Transistor with A Nanoporous Membrane for Amyloid-B Detection" ACS Nano, *15*, 8130 (2021).

[3] K. Guo, S. Wustoni, A. Koklu, E. Díaz-Galicia, M. Moser, A. Hama, A. A. Alqahtani, A. A. Nazir, F. S. Alhamlan, M. Shuaib, A. Pain, I. McCulloch, S. Arold, R. Grunberg, S. Inal, "Rapid single-molecule detection of COVID-19 and MERS antigens via nanobody-functionalized organic electrochemical transistors" Nature Biomedical Engineering 5, 666–677 (2021)