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A field-effect device for specific and label-free biosensing

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Transistor-based biosensing is the holy grail of medical diagnostics as it supports low-cost self-use and point-of-care tests in a multiplexed manner from ultra-small physiological samples. Still, transistor-based specific and label-free sensing technology is not available today despite continuous efforts during the last several decades. We recently developed and introduced the Meta-Nano-Channel (MNC) field-effect biosensor for specific and label-free sensing of diverse molecular interactions. The MNC biosensor addresses solid-solution interface challenges related to the demand for electrochemical equilibrium of solution and molecular species during measurements, and the localization challenge of molecular gating. The MNC chip is fabricated exclusively for us in a large-scale chip factory (Tower Semiconductor) providing stability, robustness, and excellent electronic grade inherent to the CMOS (complementary metal-oxide semiconductor) process. Moreover, the extreme miniaturization of CMOS technology provides the infrastructure for unparalleled multiplexed sensing from ultra-small samples, as well enabling embedded chip configurations comprising additional circuitry related to logic, switching, memory, antennas, etc. The MNC biosensor has been demonstrated for sensing in neutral solutions, diluted serum, diluted plasma, and milk samples with typical limit-of-detection (LOD) in the range of fg/mL, with about 10 orders of magnitude in dynamic range and with excellent sensitivity and linearity[1–5]. In the talk I will present the underlying methodology of the MNC biosensor. Also, I will present direct MNC biosensor measurements of several molecular interactions in 0.5 μL samples of blood and sweat samples. The measurements are performed without any sample preprocessing and without premeasurement washing steps for the removal of the non-specific species. The sensing is quantitative and performed in real-time. We believe the MNC biosensor method provides real opportunities for the utilization of FET devices towards diverse applications concerning molecular sensing.

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