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Multiplexed Extended-Gate Field-Effect Transistor Biosensing Systems: Powerful and Cost-Effective Tools for the Future of Digital Healthcare

Electronic biosensors have found numerous applications in point-of-care (POC) diagnostics thanks to their affordability and facile integration into portable devices, enabling rapid digital display of measured data. However, this class of biosensors still did not reach the stability and reliability required for demanding healthcare applications, such as the diagnostics of complex diseases or therapy monitoring, where multiple biomarkers need to be measured simultaneously with high accuracy and sensitivity. In these application scenarios, multiplexing represents a promising practical solution enabling simultaneous and reproducible measurements at many sensing points, as well as robust statistics. Extended gate (EG) field-effect transistor (FET) biosensor systems are excellent candidates for multiplexed sensing of various physiologically relevant (bio)chemical analytes, from ions to biomolecules. The FET transducer endows the system with exceptional sensitivity and straightforward interfacing with readout electronics, while the physical separation of the gate electrode from the transducer facilitates the integration of multiple individually tailored sensing points into the compact, disposable, and cost-effective sensing interface with versatile architectures [1]. We have demonstrated multiplexed, portable, and standalone EG-FET biosensing platforms combining the optimized design of conventional electronics based on off-the-shelf components and different innovative assay strategies, thereby achieving remarkable detection limits for biomolecules, improved by several orders of magnitude compared to clinical gold standard ELISA assays. Using gold nanoparticle analyte labels as nanoantennae, we realized a highly sensitive POC immunosensor [2]. Moving beyond the traditional POC diagnostics applications, we implemented an indirect assay methodology enabling the detection of target molecules relevant for monitoring cancer immunotherapy [3]. Our EG-FET platforms offer a great opportunity for advanced digitalized healthcare screening and monitoring by quickly providing more comprehensive information to clinicians. They can be easily upgraded to support data connectivity and effective incorporation of artificial intelligence. We envision EG-FET biosensing platforms as important components of future digital health ecosystems.

References

[1] Ž. Janićijević, T.-A. Nguyen-Le, and L. Baraban, 'Extended-gate field-effect transistor chemo- and biosensors: State of the art and perspectives', Next Nanotechnology, vol. 3–4, p. 100025, Sep. 2023, doi: 10.1016/j.nxnano.2023.100025. [2] Ž. Janićijević, T.-A. Nguyen-Le et al., 'Multiplexed extended gate field-effect transistor biosensor with gold nanoantennae as signal amplifiers', Biosensors and Bioelectronics, vol. 241, p. 115701, Dec. 2023, doi: 10.1016/j.bios.2023.115701. [3] T.-A. Nguyen-Le et al. 'Towards precision immunotherapy: FET biosensors for immunotherapeutic drug monitoring in UniCAR T-cell therapy', Manuscript in preparation.

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