

Silicon nanowire-based field-effect transistor array for multiple and rapid pathogen detection

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The recent outbreak of the pandemic Coronavirus disease [1] has demonstrated the need of highly sensitive and fast biosensors to detect pathogens at an early stage. Direct antigen or toxin detection rather than DNA amplification or patients' immune response analysis allows such detection in order to take immediate actions. Nanomaterial-based field-effect transistors (FETs) have demonstrated to be efficient transducers that can be modified with the corresponding bioreceptors for antigen detection with high sensitivity [2]. Here, we present a chip containing an array of 16 FETs with silicon nanowires as semiconductor channel [3]. The nanowires are defined in a honeycomb shape by an electron-beam lithography process [4], giving good mechanical stability and enhanced contact area with the sample. This area is covalently functionalized with antibodies against three different markers of pathogens, namely VP40 protein of the Ebola virus, B subunit of Cholera toxin, and Staphylococcal enterotoxin B. The array responds to the presence of the analytes in femtomolar concentrations with no cross-reaction, allowing to discriminate a lethal and potentially pandemic virus like Ebola from others that could show similar initial symptoms.

REFERENCES

- [1] World Health Organization, "Situation Report-29 SITUATION IN NUMBERS total and new cases in last 24 hours," *Coronavirus disease 2019 (COVID-19)*, 2020. [Online]. Available: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200311-sitrep-51-covid-19.pdf?sfvrsn=1ba62e57_8. [Accessed: 12-Mar-2020].
- [2] B. Ibarlucea *et al.*, *Nano Research*, 11(2) (2018), 1058.
- [3] B. Ibarlucea *et al.*, *Proceedings International Meeting on Chemical Sensors (IMCS) 2018*, 182–183.
- [4] T. Rim *et al.*, *Nanotechnology*, 25(50) (2014), 505501

FIGURES

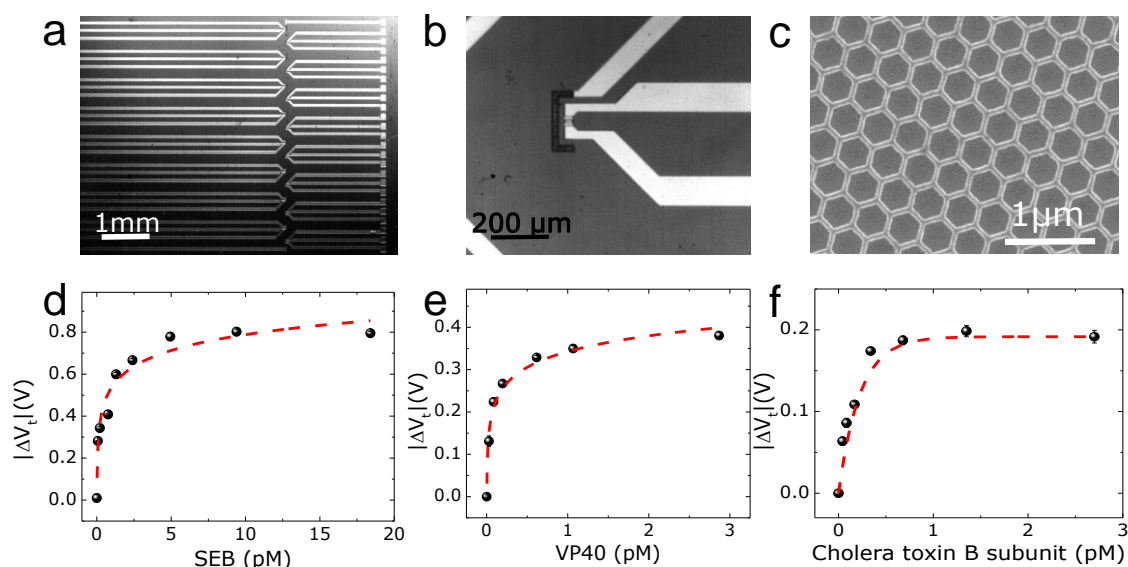


Figure 1: Sensor array and biosensing response. (a) Array of FETs, (b) Individual FET, (c) Magnification of the nanowires. (d), (e) and (f) show biosensing response for Staphylococcal enterotoxin B (SEB), VP40 from Ebola, and Cholera toxin B subunit.