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# A journey towards point-of-care devices for neurodegenerative disorders

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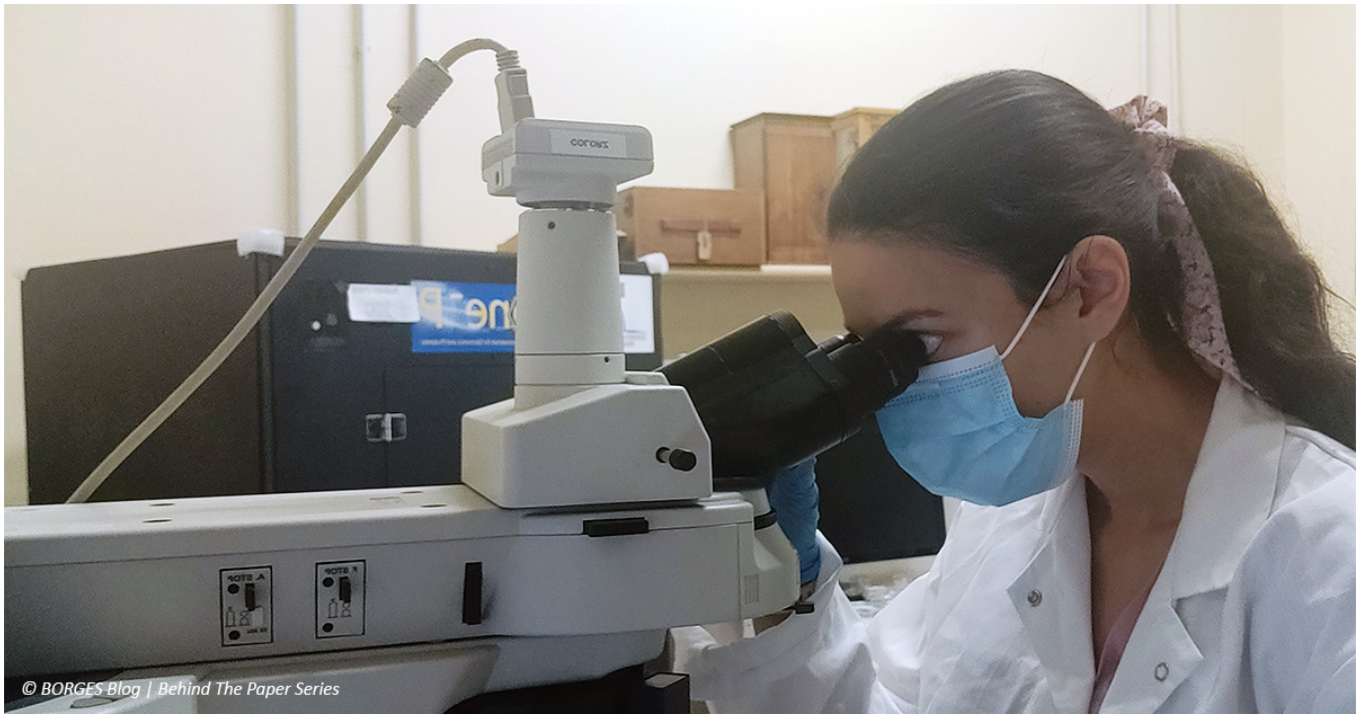


The Point-of-care (POC) devices have been significant progress in recent years, and their importance is further amplified in current situations. They allow achieving real-time diagnostic results and decreases the waiting time. At the same time, it offers the possibility of monitoring diseases and their evolution. In our present study, we focus on developing a POC device that targets α-synuclein biomarker, which hints towards possible neurodegenerative disorders such as Parkinson and Alzheimer.

The biomarkers that tell whether a disease is present or not are usually present in low concentration (nano-picomolar range) in the biological samples at the onset of the disease. Their early detection helps in the diagnosis and prognostics of the disease. Additionally, the relationship between the disease stage and the biomarker levels can

be established. In our paper, we use Electrolyte-Gated Organic Field-Effect Transistor (EGOFET) as the sensing platform, which is ideal for detecting biomarkers in an aqueous medium such as biological fluids.

The sensing mechanism is based on the biorecognition events occurring at the surface due to the antibody and antigen interactions. Therefore, the right surface chemistry and biorecognition elements are crucial. Here we took two different approached for surface chemistry and compared their sensing capabilities. In both approaches, antibodies are immobilized on the gate electrode of the transistor. One protocol contains self-assembled monolayer (SAM) and the other one with the Protein G, which is commonly used for immobilization. The orientation of the molecules on the gold surface can be a limiting factor for the antibody adsorption. Therefore, surface chemistry affects the sensing efficiency. In the end, all the results are validated with the Surface Plasmon Resonance (SPR) technique.

Along with the sensing unit, the suitable microfluidic device is designed and fabricated. It has two chambers made from PDMS (Polydimethylsiloxane) with a flexible channel connecting both of them, as shown in Figure 1(a). The microfluidic device also acts as the holder to support the substrate. The microfluidics is carefully designed to avoid the cross-contamination and it is validated with COMSOL Software for Multiphysics Simulation program. These simulations give us information about how the fluids behave near the inlet and in the microfluidic chamber. For example, the velocity fields show the maximum intensity near the widening section of the inlet, whereas it decays towards the sides of the microfluidic chamber.

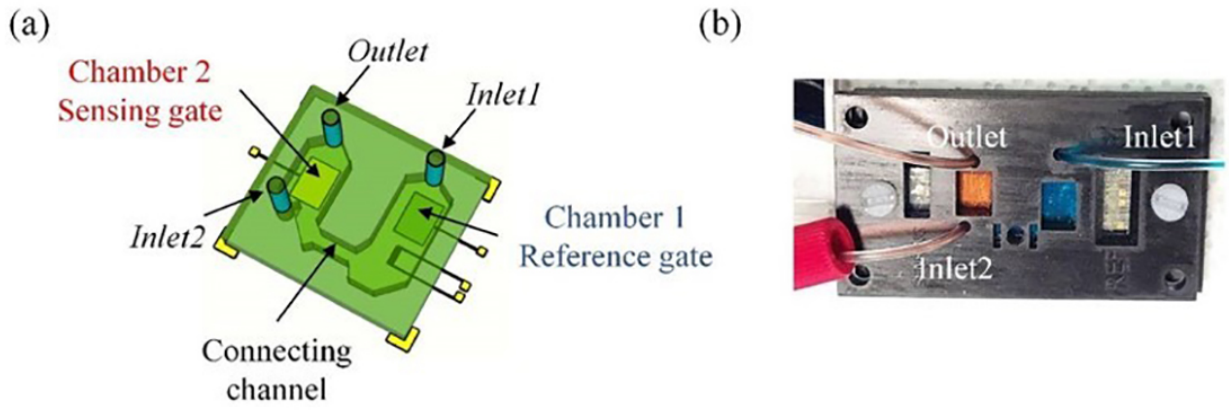


*Figure 1: (a) 3D scheme of the microfluidic setup. (b) Microfluidic setup filled with red and blue dyes in the sensing and reference chamber respectively.*

The final design consists of two chambers with separate coplanar gate electrodes termed as “reference” and “sensing”. The chamber one containing the reference gate electrode is filled with the PBS buffer solution and the chamber two is filled with different solutions with the sensing gate. The reference gate is used for characterizing the electrical performance of the organic semiconductor at the beginning and the end of the sensing experiments. By comparing the two different surface functionalization protocols, it was found that both protocols show similar sensitives; however, they offer different response ranges. Therefore, they can be used depending on the levels of biomarkers (correlated with disease stage). For the future applications, they could be used together to cover up all the range.

For more information, please check out our article "*Label-free immunodetection of α-synuclein by using a microfluidics coplanar electrolyte-gated organic field-effect transistor*" published in *Biosensors and Bioelectronics* (DOI: 10.1016/j.bios.2020.112433).

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