Optimizing Organic Electrochemical Transistors to Enhance Future Liquid Biopsies for Cancer

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Early detection is crucial for establishing a positive prognosis and outcome for cancer patients. Widely used detection methods, such as tissue biopsies and imaging, are cost-prohibitive, cumbersome, and invasive for routine monitoring. Although a liquid biopsy provides a less invasive and practical alternative to early cancer detection, its clinical application is limited by poor reliability and sensitivity. Organic Electrochemical Transistors (OECTs) can improve liquid biopsy methods because of their high functionality in aqueous environments, high transconductance, and superior ion penetration compared to conventional Field-Effect Transistors (FETs). Despite these advantages, there is still no consensus on the optimal OECT configuration for liquid biopsy applications. The purpose of this investigation was to fabricate and identify the optimal OECT architecture by comparing planar and vertical OECTs using Poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT: PSS), Poly(benzimidazobenzophenanthroline) (BBL), and Poly(glycolated bithiophene-thiophene) (p(g2T-TT)) semiconductor polymers. After fabrication, devices were analyzed for specific electrical characteristics such as threshold voltage, transconductance, and on-off ratios. The results were gauged against current FET performance metrics. The results demonstrated that the vertical OECTs that used BBL and p(g2T-TT) provided superior transconductance, threshold voltage, on-off ratio, and biomolecular sensitivity, making them viable options for integration into microfluidic liquid biopsy sensors. These favorable findings demonstrate the potential for future advancements in OECT-based biosensors, which are promising for non-invasive cancer detection.

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