IonGO: A Graphene-Printed Lab-on-PCB Sensing Platform for Real-Time Point-of-Care Testing

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Current health monitoring methods often require patients to attend hospital appointments or send samples to laboratories, resulting in prolonged waiting times (ranging from 24 hours to 21 days), increased financial costs, and heightened patient anxiety [1]. Point-of-Care testing offers efficient diagnosis at or near the patient's location, enhancing access to timely results, reducing healthcare costs, and improving patient outcomes [2]. This research presents **IonGO**, an innovative sensing platform based on graphene-printed field-effect transistors on commercial PCB (printed circuit board) substrates. IonGO enables real-time, continuous, and highly sensitive detection for point-of-care applications, addressing critical healthcare needs such as electrolyte monitoring, ICU support, and chronic disease management. The integration of graphene enhances sensor performance with optimised sensitivity, selectivity, and responsivity, as well as improving the adaptability and robustness of sensing systems for diverse analytes [3]. We demonstrate the platform's analytical capabilities through reliable and precise pH sensing (Figure 1), achieving a sensitivity of 140 μA/pH unit and a resolution of 0.04 pH units. We further extend the research towards selective ion detection such as sodium ion (Figure 2) in buffer solutions, with a detection range of 5 μmol/L to 10 mmol/L and a sensitivity of -6.34%/$\log_{10}(Na^+)$. Future development will focus on expanding detection capabilities for simultaneous multi-analyte detection in complex biological fluids using flexible substrates. With a fabrication cost of less than $0.50 per graphene-printed PCB test strip, IonGO offers a scalable and cost-effective solution with broad potential across biomedical diagnostics, environmental monitoring, and industrial process control.

References

[1] Oxford University Hospitals, Turnaround Times (2024), [Access].
[2] Larkins M., et al. National Library of Medicine (2023), PMID 37276307, [Access].
[3] Fenech-Salerno B., et al. Nanoscale (2023), 15, 3243-3254, [Access].

Figures

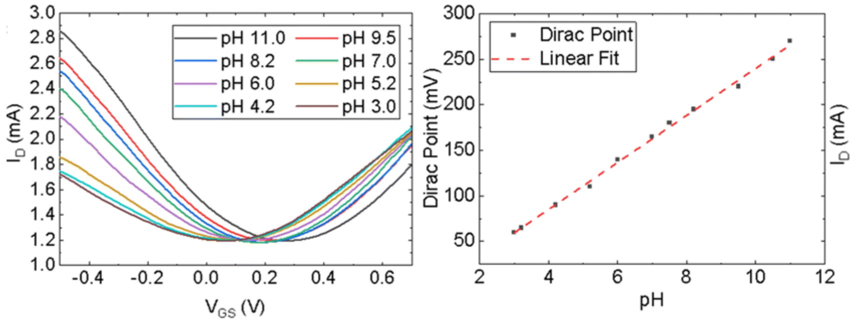

Figure 1: GFET response curves with pH changes (left); Dirac point linear fit (right).

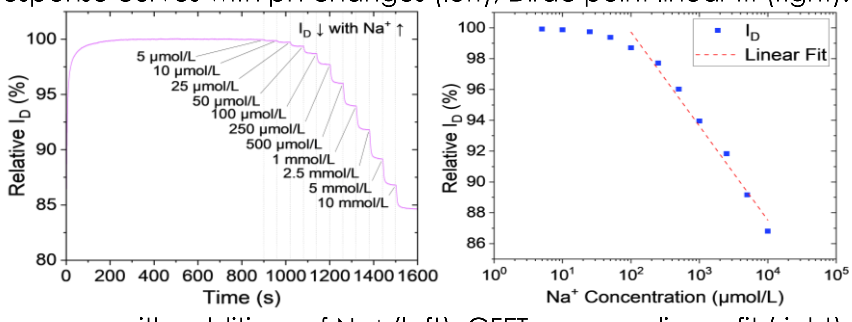

Figure 2: GFET response with additions of Na^+ (left); GFET response linear fit (right).