Designing Tunable Screen-Printed Graphitic Electrodes for Point-of-Care Diagnosis Platforms

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Screen-printed paper-based graphitic electrodes (SPGEs) offer a low-cost, simple, and mechanically flexible platform for electrochemical applications, including point-of-care diagnostics and flexible electronics. In this work, a reproducible fabrication strategy was developed to produce SPGEs with a controlled electrode thickness of approximately 43 µm, uniform ink adhesion, and high mechanical durability. The printing and curing parameters were systematically optimised to achieve low electrical resistance, stable film integrity, and consistent electrochemical performance. The SPGEs showed very well-defined electrochemical redox responses with an oxidation-to-reduction peak separation ΔEp of $<$ 120 mV and a stable surface without noticeable signal change during repeated measurements, indicating efficient electron transfer behaviour. Intra-batch and inter-batch reproducibility showed relative standard deviations (RSD) of 9.35% and 8.40%, respectively. Long-term stability tests demonstrate negligible degradation in performance over more than 90 days of ambient storage, with signal retention of more than 95 %. Further, the fabrication process is highly economical, with an estimated cost of RS 3 per chip, enabling mass production. Microscopic analysis confirmed a homogeneous graphitic electrode surface morphology, which is correlated with the stable electrochemical performance. Overall, the optimised in-house fabricated graphitic electrode provides a stable, reproducible, and flexible electrochemical platform suitable for portable, wearable, and point-of-care applications.

Reference: Yang W, Wang C (2016) Graphene and the related conductive inks for flexible electronics. J Mater Chem C 4:7193–7207. https://doi.org/10.1039/C6TC01625A

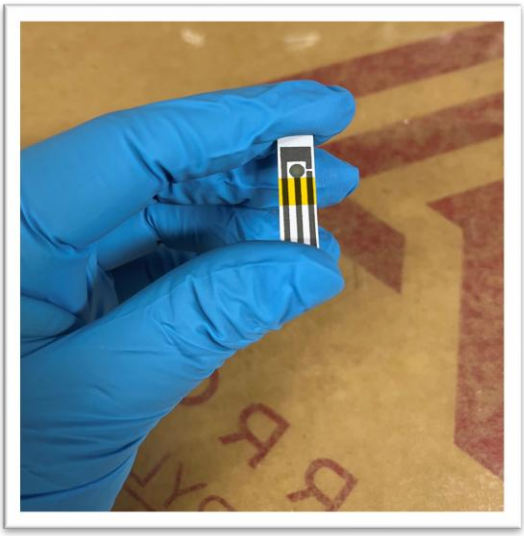

Figure 1: Fabricated Screen-Printed Graphitic electrodes