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Ultra-sensitive detection of Alzheimer's protein biomarker Clusterin using novel Graphene/hBN transducers and Electrical Quantum Transport Admittance Spectroscopy (e-QTAS)

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Worldwide prevalence of dementia is estimated to rise from the current 50 million people affected to 152 million by 2050, costing healthcare systems ~2% of the global GDP to diagnose, treat and care for patients [1]. Although there are over 130 different types of dementia, Alzheimer's disease (AD) accounts for 60-70% of all cases. Methods for early diagnosis of AD could significantly impact disease detection, progression monitoring and therapeutics. This grand challenge requires ultra-sensitive and specific sensors to detect concentration level changes in patients significantly earlier than current diagnostic techniques employing MRI, CT, PET scans, blood tests and memory tests, often taking around 2 years to complete. We have therefore developed novel graphene/hBN transducers for the ultra-sensitive detection of AD protein biomarkers, such as Clusterin a molecular chaperone associated with AD, using electrical Quantum Transport Admittance Spectroscopy (e-QTAS). The graphene/hBN [2] transducers were fabricated on Si/SiO_2 substrate using photolithography with evaporated chromium and sputtered gold contacts. The transducer channels were functionalized with linker molecules, 1-Pyrenebutyric acid *N*-hydroxysuccinimide (Pyr-NHS) ester, to immobile anti-Clusterin antibody (Ab) [3]. Binding reaction of the antibody with varying concentration levels of Clusterin antigen demonstrated the limit of detection of the transducers to be better than 10 fg/mL using four-probe direct current-voltage (DC-IV) and e-QTAS [4,5]. The developed transducers are generic, selective, fast, low-cost and could find applications in a broad range of point-of-care medical diagnostics in addition to neurodegenerative diseases (Alzheimer's, Parkinson's, etc.), such as cancer and cardiovascular disorders. We acknowledge funding from the UK's EPSRC, EP/M006301/1 and University of Plymouth, GD105227.

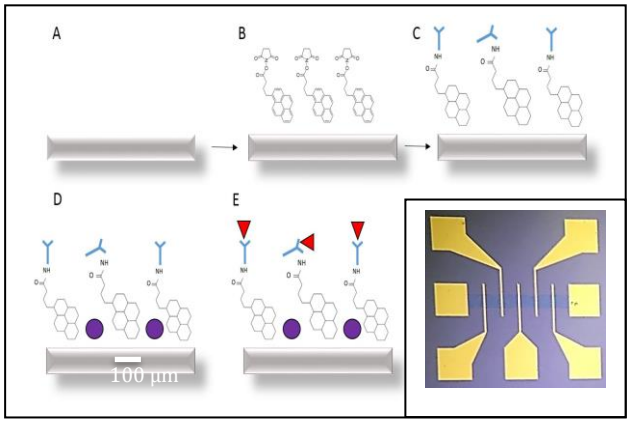

Fig. 1. Graphene/hBN device functionalisation *(A: Graphene/hBN, B: Pyr-NHS, C: Ab, D: Bovine Serum Albumin E: Clusterin)* with inset showing fabricated transducers for the detection of Clusterin, key a biomarker of AD.

References

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