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Detection of Alzheimer's protein biomarker Clusterin using Graphene transducers

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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. Meeting this need requires sensitive and specific sensors to detect concentration level changes in patients significantly earlier than current diagnostic techniques employing MRI, PET scans etc. We have therefore developed novel graphene transducers for the sensitive detection of AD protein biomarkers, such as Clusterin a molecular chaperone associated with AD, using electrical admittance spectroscopy. The graphene transducers [2] were fabricated on Si/SiO₂ 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 1 pg/mL using four-probe direct current-voltage (DC-IV) measurements [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.

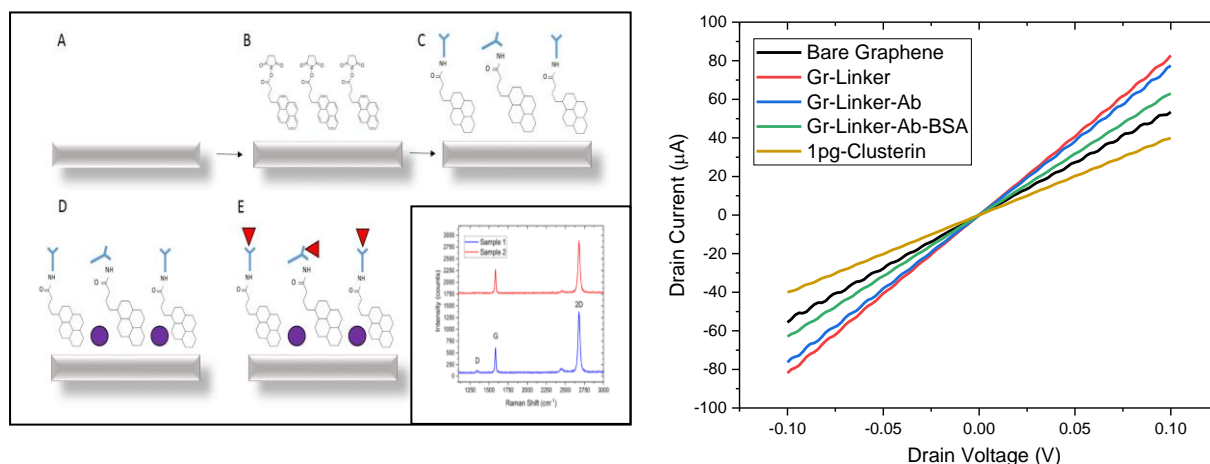


Fig. 1. Graphene device functionalisation (A: Graphene/hBN, B: Pyr-NHS, C: Ab, D: Bovine Serum Albumin E: Clusterin) with inset showing Raman spectra of the graphene channel (left) and detection of Clusterin at 1pg/mL concentration using DC 4-probe I-V electrical measurements (right).

References

- [1] World Alzheimer's Report 2018, *Alzheimer's Disease International*, Sept 2018.
- [2] Wang R., Hofmann S., et al., "A peeling approach for integrated manufacturing of large monolayer h-BN crystals", *ACS Nano*, **13**, 2114-2126, 2019.
- [3] Haslam C., Awan S.A., et al., "Label-free sensors based on graphene field-effect transistors for the detection of Human Chorionic Gonadotropin cancer risk biomarker", *Diagnostics*, **8**, 5, 1-13, 2018.
- [4] Awan S. A., et al., "Transport conductivity of graphene at RF and microwave frequencies", *2D Mater.*, **3** (1), 015010-1-11, 2016.
- [5] Awan S. A., et al., "Transport electromagnetic properties of chemical vapour deposition graphene from direct current to 110 MHz", *IET Circuits, Devices Syst.*, **9** (1), 46-51, 2015.