

Abstract

Graphene FET Sensors for Alzheimer's Disease Protein Biomarker Clusterin Detection

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Abstract: We report on the fabrication and characterisation of Graphene field-effect transistor (GFET) Biosensors for detecting clusterin, a prominent protein biomarker of Alzheimer's disease (AD). There are approximately 54 million people currently living with dementia worldwide and this is expected to rise to 130 million by 2050. Although there are over 400 different types of dementia, AD is the most common type, affecting between 50-75% of those diagnosed with dementia. Diagnosis of AD can take up to 2 years currently using MRI, PET, CT scans and memory tests. There is, therefore, an urgent need to develop low-cost, accurate, non-invasive and point-of-care (PoC) sensors for early diagnosis of AD. The GFET sensors we are developing to address this challenge were fabricated on Si/SiO₂ substrate through processes of photolithographic patterning and metal lift-off techniques with evaporated chromium and sputtered gold contacts. Raman Spectroscopy was performed on the devices to determine the quality of the graphene. The GFETs were annealed to improve their performance before the channels were functionalized by immobilising the graphene surface with a linker molecule and anti-clusterin antibody. The detection was achieved through the binding reaction between the antibody and varying concentrations of clusterin antigen from 1pg/mL to 1ng/mL. The GFETs were characterized using 4-probe direct current (DC) electrical measurements which demonstrated a limit of detection of the biosensors to be below 1pg/mL.

Keywords: Graphene; FET; biosensor; diagnosis; electrical detection; clusterin; Alzheimer's disease; dementia; protein biomarkers



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