Non-covalently modified graphene FET for the label-free detection of exosomes as biomarkers

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Using graphene for biomedical applications has thus far shown promising results for the early stage detection of disease and point-of-care diagnostics. Graphene's excellent electronic transport properties enable the fabrication of high sensitivity biosensors for the label-free identification of cancer biomarkers with low detection limits [1]. In particular, the isolation of micro-sized exosomes as cancer biomarkers, has recently grown significantly in interest due to the information they carry about the cell type from which they are derived [2]. We report a large-area chemical vapour deposition graphene device, with the potential for microfluidic integration, for the detection of exosomes to 10^{-2} μg/μL concentrations. By fabricating a graphene field effect transistor structure and functionalizing its surface with the necessary non-covalent linker molecules (fig.1), respective shifts in graphene's Dirac point are observed (fig. 2) due to their effect on the carrier density and mobility [3]. Hence, even at low concentration levels, exosomes are successfully detected by the functionalized graphene FET biosensor. Ultimately, we aim to refine the sensing device and push its detection limit lower.

References

[1] Fu, Wangyang, et al., Nanoscale 5, 24 (2013) 12104-12110.

Figures

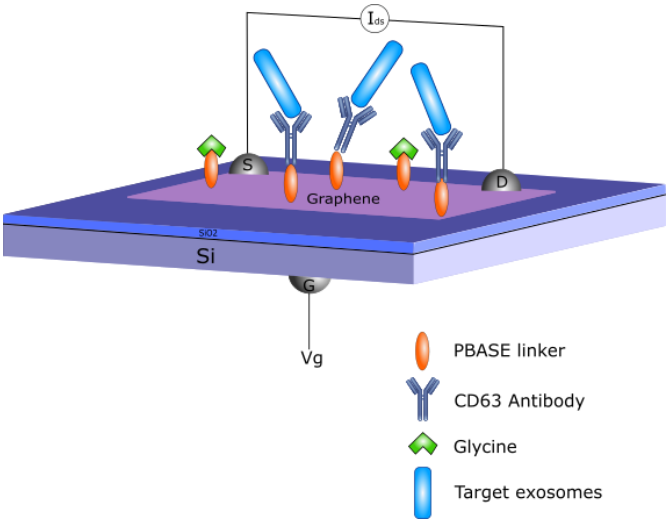

Figure 1: Schematic of the graphene FET biosensor showing each layer of functionalization.

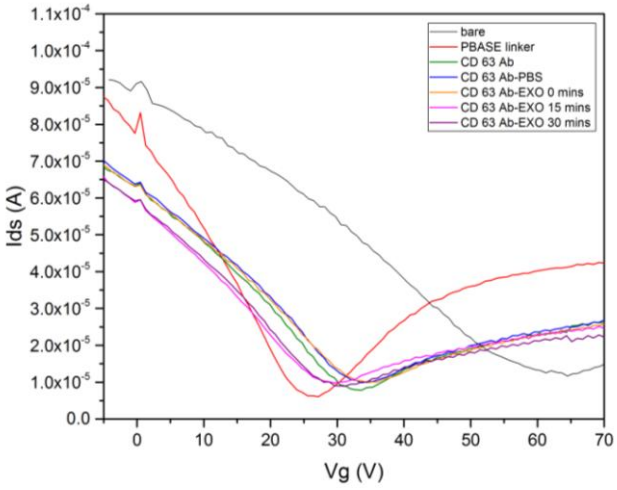

Figure 2: The IV characteristic with each layer of functionalization with Vds = 200 mV. Exosome measurements were taken at various times after introduction to the graphene surface.

[2] Lee, Kyungheon, et al., ASC Nano 9, 3 (2015) 2321-2327.
[3] Ping, Jinglei et al., Biosensors and Bioelectronics, 89, part 1 (2017) 689-692.