Cortisol Detection based on functionalized Graphene Field-Effect Transistors

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Graphene-based detection systems have emerged as promising alternatives due to their compact size, portability, low power consumption, and non-invasive data acquisition, exploiting graphene's unique electrical and mechanical properties. Biosensors based on graphene field-effect transistor (GFET) arrays have demonstrated the ability to detect specific target molecules by slight changes in the electrical characteristics of functionalized graphene upon exposure to the target molecule.[1] The non-covalent functionalization of graphene provides a robust foundation for immobilizing specific antibodies. For device fabrication with the Functional Layer Transfer process (FLaT), CVD-grown graphene is functionalized with perylene bisimide (PBI) directly after growth, and then applied to a SiO_2/Si substrate via a polymer assisted transfer. After contacting with gold electrodes, the PBI-functionalized graphene is chemically coupled with an antibody fragment that specifically binds the target molecule. This functionalization methodology has been successfully applied in both methamphetamine and cortisol GFET biosensors,[2] highlighting the versatility and universality of this approach for detecting various target molecules. By leveraging the electrical alterations in non-covalently functionalized graphene, electrical measurements were able to demonstrate a concentration-dependent response when exposing the sensing device to cortisol.

References

[1] S. Winters, N. C. Berner, R. Mishra, K. C. Dümbgen, C. Backes, M. Hegner, A. Hirsch, G. S. Duesberg, Chem. Comm., 51 (2015).
[2] L. von Lüders, R. Tilmann, K. Lee, C. Bartlam, T. Stimpel-Lindner, T. K. Nevanen, K. Iljin, K. C. Knirsch, A. Hirsch, G. S. Duesberg, Angew. Chem. Int. Ed., 62 (2023).

Figures

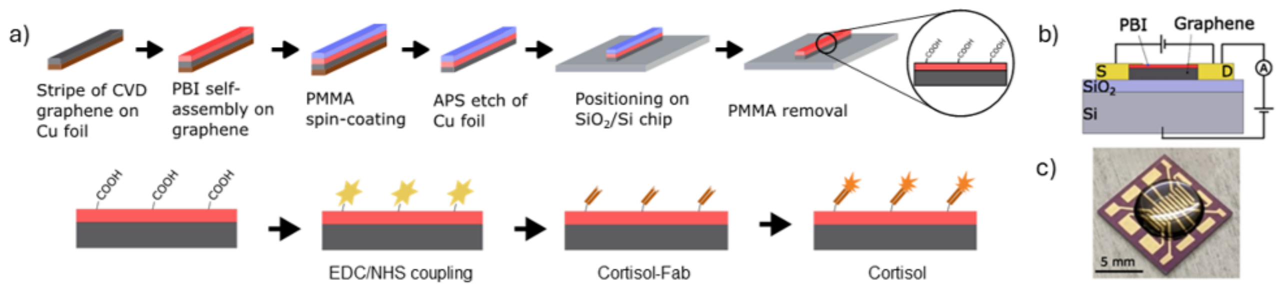

Figure 1: a) A schematic fabrication procedure of a cortisol GFET sensor. b) A schematic representation of the GFET sensor device. c) A photo of a GFET sensor device.