A universal sensing platform based on carbon nanomembrane (CNM)/graphene heterostructures

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Abstract

Chemical functionalization of single-layer graphene (SLG) is of key importance for applications in functional electronic devices such as, e.g., field effect transistor (FET) based nanosensors. However, the electronic structure of graphene is typically degraded after the functionalization, which significantly restricts the applications. Here, we present a universal route to non-destructive chemical functionalization of graphene FETs with amino terminated 1 nm thick carbon nanomembranes (NH_2-CNM) generated via electron beam induced crosslinking of aromatic self-assembled monolayers. [1-3] We demonstrate in detail characterization of the transport properties of these heterostructures and employ them for highly sensitive detection of pH-values at physiological conditions. Additional biochemical functionalization of NH_2-CNM enables development of custom designed highly sensitive (detection limit below 1 pM) and highly selective biosensors for detection of biomarkers in clinical diagnostics. [4-5]

References

[1] M. Woszczyna, A. Turchanin, et al., Adv. Mater. 26 (2014), 4831-4837.
[2] A. Turchanin, A. Gölzhäuser, Adv. Mater. 28 (2016) 6075-6103.
[3] A. Turchanin, Ann. Phys. 529 (2017) 1700168
[4] A. Turchanin, Patent US 9735366 B2
[5] http://www.poc-id.eu

Figures

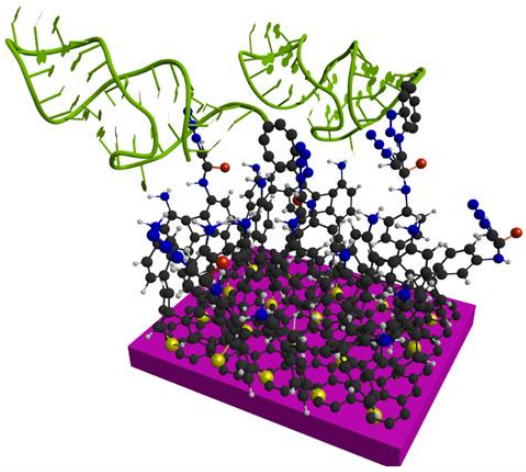

Figure 1: Schematic representation of a CNM/graphene heterostructures on a solid substrate (SiO_2, PET, PEN, etc.). CNM is functionalized by biological receptors.

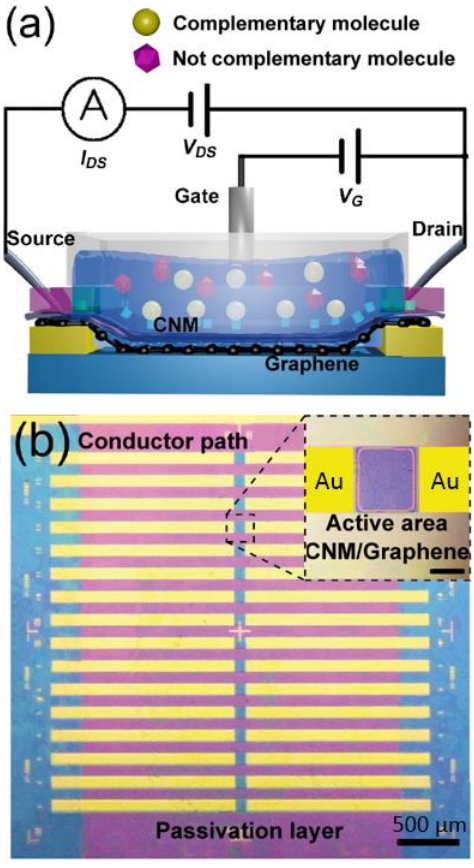

Figure 2: (a) Schematic representation of a CNM/graphene FET biosensor. (b) Optical image of a sensor array. Size of the scale bar in the insert is 50 µm.