Heterostructures of 2D carbon materials as a platform for electrochemical sensing

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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 employ a route to non-destructive chemical functionalization of graphene with amino terminated 1 nm thick carbon nanomembranes (NH_2-CNM) generated via electron beam induced crosslinking of aromatic self-assembled monolayers. [1, 2] The electrical response of the NH_2-CNM/SLG heterostructures in an electrolyte-gated FET shows its high capacitance and an enhanced mobility of graphene due to the dielectric screening of charged impurities with CNMs in comparison to bare graphene devices. The electrochemical performance of this CNM/graphene hybrids has been studied for detection of pH values. We show that the electronic structure of pristine SLG is preserved in the amino-terminated hybrids and that sensing of pH is possible with high sensitivity and reproducibility.

References

[1] A. Turchanin and A. Gölzhäuser, Advanced Materials, 28 (2016) 6075-6103
[2] M. Woszczyna, A. Winter, M. Grothe, S. Wundrack, R. Stosch, T. Weimann, F. Ahlers, A. Turchanin, Advanced Materials, 26 (2014), 4831-4837

Figures

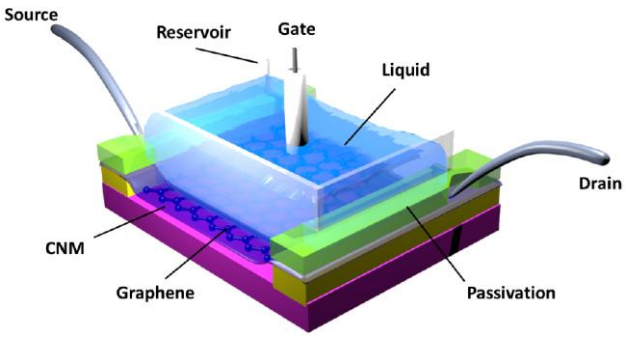

Figure 1: Schematic illustration of the liquid gated CNM/SLG device.