Graphene nanopore platform for single-molecule studies

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Abstract

Graphene employed in many research fields often showed unmatched, or distinctively unique properties within the given field. We demonstrate that graphene-based nanopore sensors have potential resolution and sensitivity to non-destructively read out individual nucleobases along the long DNA molecule [1] – which is the paramount challenge in the field of physical DNA and protein sequencing.

In a nanopore device, individual DNA molecule in aqueous salt solution is threaded through a nanometer-scaled pore in a linear fashion, allowing for sequential parts of the molecule to be localized and interrogated within the pore. The properties of the localized part of the molecule can be deduced by measuring ionic current modulation through the obstructed nanopore, or by monitoring current in a nanopore-integrated electrical sensor. We show that single-layer graphene membrane has sub-nanometer effective thickness in water, lending to graphene nanopores sub-nanometer resolution along the length of a DNA molecules [1]. Furthermore, we demonstrate that graphene nanopores have ultrahigh sensitivity on diameter variations of the threading molecule, which is the direct consequence of graphene's monoatomic thickness [2]. Finally, we discuss the physical properties of graphene nanopores, their interaction with the DNA molecules, and implications of our results on the prospects for next-gen DNA sequencing.

References

[1] Garaj, S. *et al.* Nature **467** (2010) 190–193.

[2] Garaj, S., Liu, S., Branton, D. & Golovchenko, J. A. arXiv:12044361 (2012).