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DNA Electronic Fingerprints by Local Spectroscopy on Graphene[1]

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Working and scalable alternatives to the conventional chemical methods of DNA sequencing that are based on electronic/ionic signatures would revolutionize the field of sequencing. The approach of a single molecule imaging and spectroscopy with unprecedented resolution, achieved by Scanning Tunneling Spectroscopy (STS) and nanopore electronics could enable this revolution. We use the data from our group [1] and others in applying this local scanning tunneling microscopy and illustrate possibilities of electronic sequencing of freeze dried deposits on graphene. We will present two types of calculated fingerprints: first in Local Density of States (LDOS) of DNA nucleotide bases (A,C,G,T) deposited on graphene[2]. Significant base-dependent features in the LDOS in an energy range within few eV of the Fermi level were found in our calculations. These features can serve as electronic fingerprints for the identification of individual bases in STS. In the second approach we present calculated base dependent electronic transverse conductance as DNA translocates through the graphene nanopore. Thus we argue that the fingerprints of DNA-graphene hybrid structures may provide an alternative route to DNA sequencing using STS.

[1] Yarotski DA, Kilina SV, Talin AA, Tretiak S, Prezhdo OV, Balatsky AV, Taylor AJ., "Scanning tunneling microscopy of DNA-wrapped carbon nanotubes." Nano Lett. 2009 Jan;9(1):12-7
[2] Ahmed T, Kilina S, Das T, Haraldsen JT, Rehr JJ, Balatsky AV, "Electronic Fingerprints of DNA Bases on Graphene," Nano Lett., 2012, v 12 Issue: 2 Pages: 927-931 DOI: 10.1021/nl2039315

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[2]Work done in collaboration with T. Ahmed, J. Haraldsen, D. Yarotski, S. Kilina, T. Das, J. Rehr, S. Tretiak, A. Taylor, K. Wikfeldt, A. Talin, N. Modine, O. Prezhdo, I.K. Schuller, M. DiVentra.