MORPHOLOGICAL AND ELECTRICAL CONTRAST DEPENDENT DNA STM IMAGING OF G4-DNA AND POLY(G)-POLY(C) DNA

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One of the most intensively studied subjects in the field of nanoelectronics is the electric properties of biomolecules, such as DNA and the development of new molecules that can serve as good molecular nanowires.[1] In this work we present two aspects of our research in this field:

(a) The puzzle of topography contrast inversion in DNA STM imaging:[2]

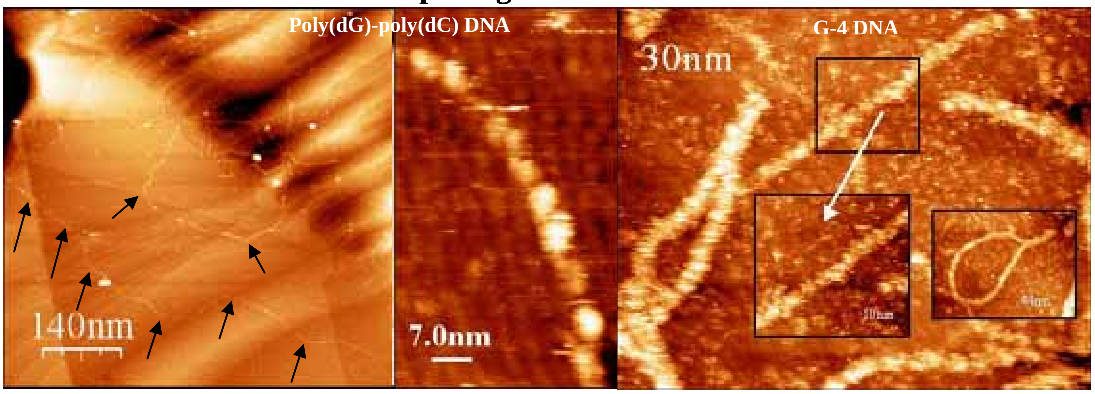
In some STM measurements reported so far,[3] the DNA appeared with negative contrast, *i.e.*, "submerged" under the metal background and darker. According to WKB theory,[4] commonly used for STM images interpretation, contrast inversion implies that the DNA workfunction is lower than the surrounding metal, in dissonance with common understanding. Here, we report controlled (using current and bias voltage settings) and spontaneous contrast inversions of the DNA in the STM images and dependence of the DNA apparent height on the bias voltage. Using these characterizations, we formulate a model explaining the above phenomenon by resonant tunneling through virtual states in the vacuum between the STM tip and the DNA.

(b) Morphological characterization of novel monomolecular G4-DNA and its comparison to poly(dG)poly(dC):[5]

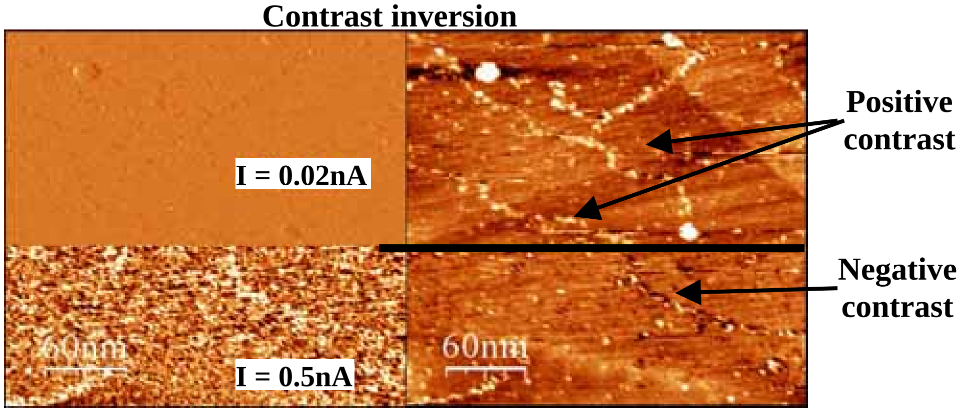
G4-DNA is a 4-stranded DNA-based molecule, made of a linear arrangement of guanine tetrads. The G4-DNA wires reported so far were comprised of a large number of oligonucleotide fragments, which resulted in non-uniform structures with nicks between the oligonucleotide fragments. This fragmentation may strongly reduce the ability of the wires to conduct current, thus limiting their application for nano-electronics. Here we report STM characterization of novel long (~1 μm) and stable monomolecular G4-DNA wires that are formed by intra-molecular four-folding of single, long (kilo-bases) poly(G) strands and compare it to the poly(dG)-poly(dC) molecules that serve as its starting material. The morphological results will include high quality STM images of poly(dG)-poly(dC) and G4-DNA, showing their inner molecular structure, *i.e.* the helical periodicity seen as repeating grooves along the molecules.

The figures below demonstrate some of the material that will be presented in the poster:

Morphological characterization



Contrast inversion



Current image Topographic image

References:

P[1] PPorath, D., Cuniberti, G. & Di Felice, R. “Charge transport in DNA-based devices” in *Long Range Charge Transfer in DNA II.*(ed.Schuster, G.) Vol. **237**, 183-228 (Springer-Verlag, Heidelberg,2004).

P[2] PShapir, E., Yi, J., Cohen, H., Cuniberti, G. & Porath, D. The puzzle of contrast inversion in DNA STM imaging. (submitted).

P[3] PLindsay, S.M., Thundat, T. & Nagahara, L. Biopolymers **152**, 213-220 (1988).

P[4] PWiesendanger, R. “Scanning prob microscopy and spectroscopy”. (Cambridge University press, 1994)

P[5] PKotlyar, A.B., Borovok, N., Molotsky, T., Cohen, H., Shapir, E. and Porath D. *Novel Long Monomolecular G4-DNA Nanowires*. (submitted).