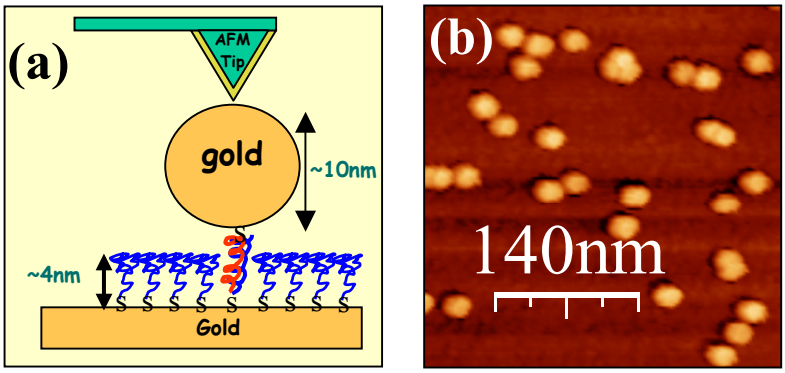
SPM AND CHARGE TRANSPORT MEASUREMENTS THROUGH DNA MOLECULES OF COMPLEX SEQUENCE

Hezy Cohen[1], Claude Nogues,[1,2] Ron Naaman,[2] and Danny Porath[1]

1- *Physical Chemistry Department, The Hebrew University, Jerusalem* 91904, *Israel*
2- *Department of Chemical Physics,The Weizmann Institute, Rehovot* 76100*, Israel.*

E-mail: porath@chem.ch.huji.ac.il



Schematic of the experiment (a) and a topography image of gold nanoparticles connected through double-stranded DNA to an underlying gold surface surrounded by a single-stranded DNA monolayer.

The ability of DNA to transport charge carriers and the possible mechanisms for this transport were debated over the past few years.[1] Part of the debate originated from the variety of measurement approaches, samples preparation, experimental set-ups and environmental conditions. The two main factors that limited charge transport in measurements previously reported were the attachment to the surface along the molecule and the non-chemical bonding of the molecules to the contact electrodes. Indeed, current was measured in short molecules and blocked in long molecules attached to the surface.

Inspired by Cui *et al.*,[2] we have adopted an experimental approach that enables to overcome these difficulties by measuring current through DNA molecules chemically connected on both sides to a metal substrate and a gold particle, which is contacted *in a controlled way* by a metal atomic force microscope (AFM) tip. Here, we report clear evidences for charge transport through 26 base-pairs long DNA molecules of complex sequence, in which we measure currents higher than 220 nA at 2 V. Moreover, we observe a non-zero gap and a peak structure in the current-voltage curves that is reproduced for many molecules and by two different measurement methods.

We present a comprehensive set of control experiments that verify our findings. These include: simultaneous topography-current maps, measurements on non-complementary strands, current-distance upon stretching the molecules, 3D-mode measurements performed on the insulating surrounding layer and checking the effect of humidity.

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[1] Porath, 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).

[2] Cui, X. D.; Primak, A.; Zarate, X.; Tomfohr, J.; Sankey, O. F.; Moore, A. L.; Moore, A. t.; Gust, D.; Harris, G.; Lindsay, S. M. *Science* **2001**, *294*, 571.