Conductance Measurements of Single Biological Molecules

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Understanding the complexities of the conductance of biomolecules has proven to be an arduous task. The difficulties in measuring the charge transport in a single molecule through direct contact is often exacerbated in the cases of biomolecules due to the effects of environment that change drastically between experimental conditions which cause differences in the configuration of the molecule and the local interference effects. As such, not only the conductance value, but even the conductance mechanism of DNA has been widely disputed in the literature, however, photochemical and nanoscale contact measurements tend to show that DNA is capable of some charge transport[1, 2]. We have used a Scanning Tunneling Microscope Break Junction to create Au-molecule-Au junctions and probe the conductance of single DNA molecules via a statistical analysis of 1000's of junctions allowing for simple, repeatable measurements. In the case of DNA, we have demonstrated that the conductance changes significantly with length. All measurements on DNA are carried out in a buffered, aqueous solution helping to maintain a biological conformation of the DNA, and thus alleviating the confounding issues of conformational changes in dry environments. The addition of Adenine(A)-Thymine(T) base-pairs causes an exponential decrease in the conductance, suggesting a tunneling mechanism. Whereas, the addition of Guanine(G)-Cytosine(C) base-pairs shows a weak algebraic dependence on the conductance suggesting a hopping mechanism. To further investigate the conductance mechanism in DNA we have chosen an alternating GC sequence with a length of eight base pairs and systematically changed the temperature and the electrochemical potential of the Metal-Molecule-Metal junction to help elucidate the conductance mechanism.

1. Schuster, G. B., *Long-Range Charge Transfer in DNA I*. ed.; Springer-Verlag: Berlin, Germany, 2004; 'Vol.' 236, p.
2. Schuster, G. B., *Long-Range Charge Transfer in DNA II*. ed.; Springer-Verlag: Berlin, Germany, 2004; 'Vol.' 237, p.

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