Electrical conductivity of DNA molecules

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Last years interest to processes of charge transport in DNA molecules has considerably increased. That is connected with the prospects of their use in nanoelectronic devices. The attempts to measure electric resistance of DNA resulted in contradictory conclusions: the molecule can show properties of a dielectric [1], a semiconductor [2], a metal [3] and even a superconductor [4]. The reasons of such ambiguity of results is complexity of the DNA molecule structure, and also uncertainty in treatment of experimental results.

There are two most often used methods for conductivity research of the DNA molecule. In the first case the isolated DNA molecule is placed between two electric contacts. The distance between electrodes should be small (about 1-10 nm), but sufficient enough to interfere with tunneling of charges. Such experiment is rather hard to carry out and particularly difficult to control.

The second approach to measurement of conductivity of individual molecules is based on the use of a scanning tunneling microscope (STM) [5]. The very first experiments with the use of STM have shown that it is the most suitable tool for researches of both single DNA molecules and molecules in monolayer films. However, running of qualitative and unambiguous experiments on measurement of charge transport through a single molecule by means of STM is extremely difficult, and interpretation of the received results appears even more difficult.

After a series of STM images receiving and identification of the DNA molecules on these images, the current-voltage curves of the DNA molecules have been measured (Fig. 1).

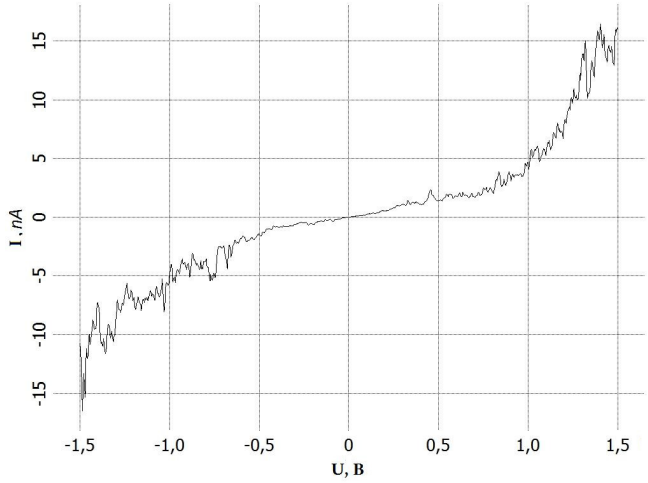

Fig. 1. Current-voltage curve of the DNA molecules.

The current-voltage curve has shown a symmetric appearance concerning zero values. The kind of curve is nonlinear. On sites of the current-voltage curve with the pronounced manifestation of nonlinearity, the growth of a tunnel current dispersion of fluctuations has been observed.

References

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