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The current in protein nanowires: quantum calculations of basic states

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In paper [1] considered the primary structure of protein molecule from the point of view of possibility to consider it as a nanowire for electronic transport in the metabolism (redox process).

Analysis of the average electronic configuration of the protein molecule was made and it was shown, that in the energy of interaction between the electron and nuclear subsystem actually saves non-compensated contributions.

They are caused by radicals and provide the active transport of electrons along the primary structure of protein molecules.

Based on the model of oxygen electronic configuration of protein (in average), considered in [1], we analyzed here the quantum structure of the conduction band. In proteins it associated with one of the three 2p-states which have the highest energy. It is shown that obtained conductivity band splits into five sub bands. Three of them have a normal dispersion (the dependence of energy on the wave vector) and ensures the normal direction of nano-current (current from one electron). Two other sub bands has an anomalous dispersion and, accordingly, anomalous (reverse) direction of nano-current. It has been shown that the presence of such a structure of the conduction band leads to absence of current of injected electron in the approximation of complete absence of external fields. This result is a direct confirmation of the reality of the obtained structure of the conduction band.

Obtained also approximate analytical formulas for energies of all sub bands, which have a high enough integral precision (error some percent). They provide a relatively simple technical possibility for calculation of the nano-current in the presence of an external field, and also the other physical properties of proteins, which are associated with the dispersion.

1. *Anatol D Suprun and Liudmyla V Shmeleva*. Primary structure of proteins as a nanowire for metabolic electronic transport. // Nanoscale Research Letters. -2015- **10(1). -**P. 121-128.