Charge transfer mechanism along the DNA double helix

G.P.Triberis

University of Athens, Department of Physics, Solid State Section
Panepistimiopolis, 157 84, Zografos, Athens, Greece

Experimental results and contradictory theoretical interpretations have spurred intense debate over the charge transfer mechanism along the DNA double helix. The enlightenment of this issue is of fundamental importance in the long range chemistry of oxidative DNA damage and repair processes [1], monitoring protein-DNA interactions, while novel research areas of the dynamics, response and function of nanostructures and biosensors are emerging [2-4]. Multiphonon-assisted small polaron hopping between neighbouring base pairs is proposed as a possible charge transfer mechanism for the interpretation of the strong temperature dependence of the electrical conductivity measured at high temperatures along the DNA double helix [5,6]. The proposed model takes into account the one-dimensional character of the system and the presence of disorder resulting from the random base sequences and the randomly positioned positively charged counterions along the backbone of the DNA helix. The importance of correlations between successive hops is also discussed. The analytical expressions for the temperature dependence of the electrical conductivity and the maximum hopping distance obtained, based on percolation-theoretical considerations, are successfully applied to experimental data reported for the λ-DNA and the poly(dA)-poly(dT) DNA [7-9].

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