The role of solitons on the properties of electron transport through DNA-based transistor-a Green's function approach

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Abstract: In this work, we present a theoretical study of the conductance properties of molecular transistor model. The model considered has Metal/DNA/Metal structure.
Using a tight-binding Hamiltonian model [1] and the method based on generalized Green's function theory [2,3] with the Lowdin partitioning technique [4] and also Peyrard-Bishop model for describing the soliton in DNA [5,6], we investigate the role of the soliton in DNA electronic states (Fig.1) and in the I-V characteristics (Fig.2) of the Metal/DNA/Metal transistor. Our results show that in the presence of a distribution of solitons the band structure changes greatly and soliton states are created within the gap. In addition the voltage drop along the molecule give rise to a significant enhancement in the conductance. Also we study the effect of Metal/DNA coupling strength (Fig.3) and the length of the DNA molecule (Fig.4) on electronic state of the Metal/DNA/Metal transistor.

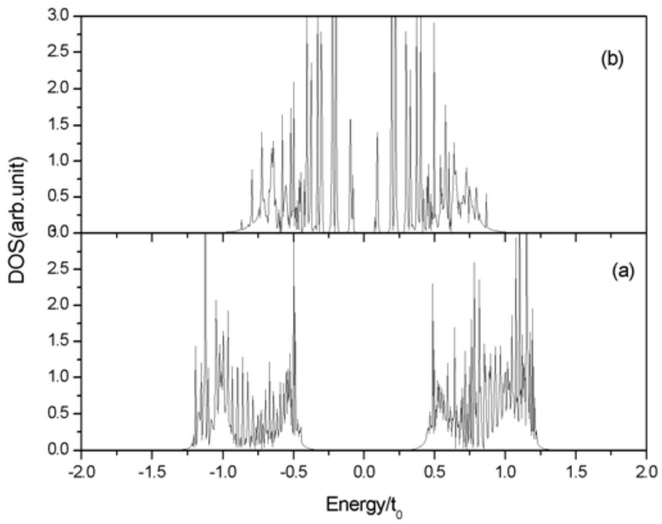

Figure1: Electronic Density of State (DOS), (a)in the absence and, (b) in the presence of solitons for 30 base-pairs in Metal/DNA/Metal Transistor.

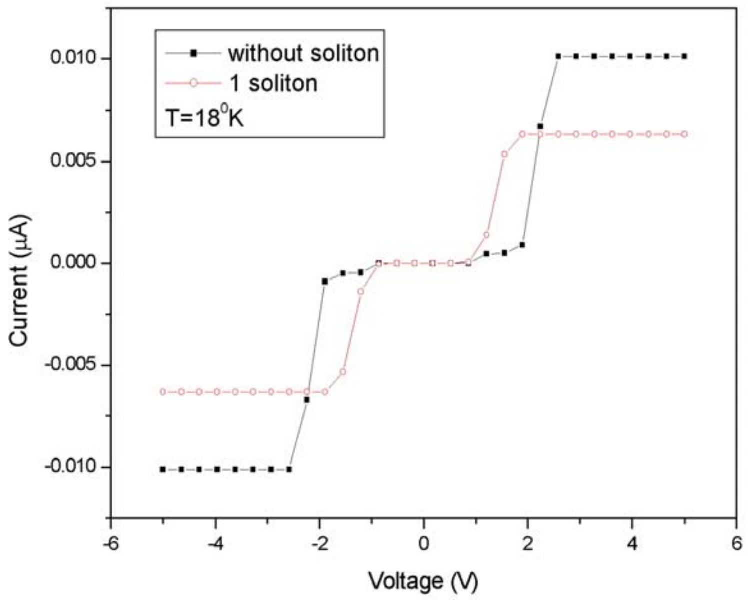

Figure 2: Approximate I-V Characteristics of Metal/DNA/Metal transistor in the absence and presence of soliton.

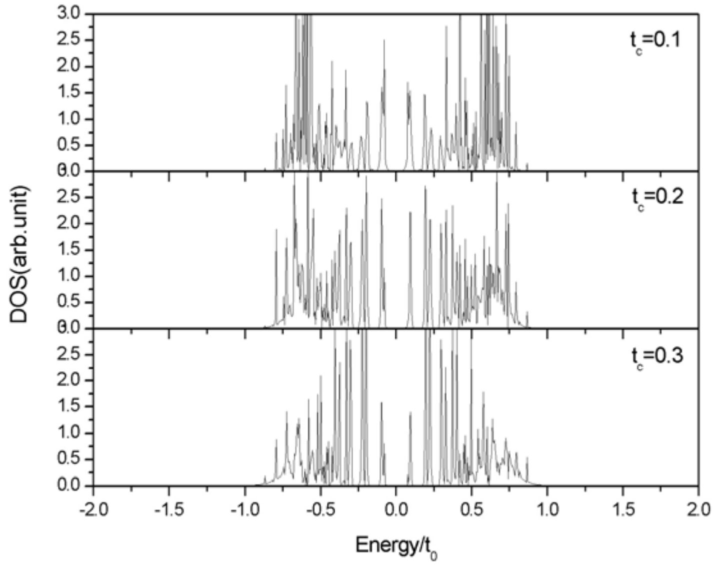

Figure 3: Density of states (DOS) for different amount of t_c in the presence of solitons for 30 base-pairs in the Metal/DNA/Metal transistor.

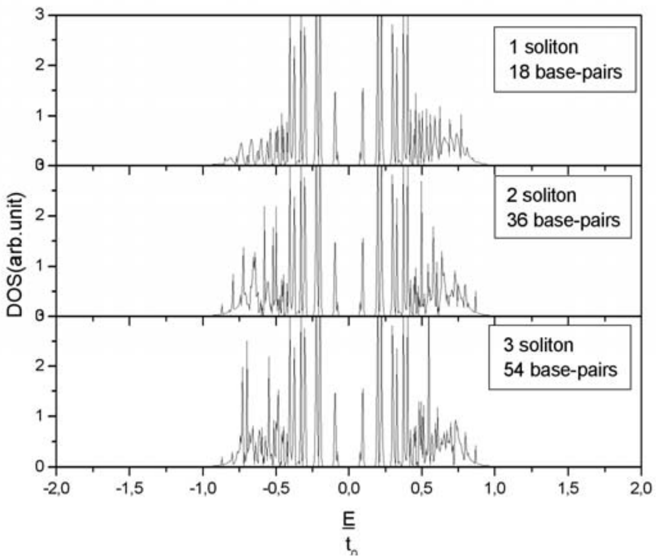

Figure 4: Density of state(DOS) for different number of solitons and base-pairs in the Metal/DNA/Metal transistor.

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