Generalized Charge Transfer (GCT) Model for Analysis of Transport Phenomena in Molecular and DNA π-stacks devices

V. Burtman,1 T. N. Kopylova,2 R. M. Gadirov,2 E. N. Tel'minov,2 S. Yu. Nikonov,2 and E. N. Nikonova2.

Utah State University, Salt Lake City, USA *and* Siberian Physical-Technical Institute at Tomsk State University, Tomsk, Russia

This report explores possibilities to achieve fast and long-range charge transport in molecular pi-stacks. We use Molecular Layer Epitaxy (MLE) method to produce highly ordered molecular pi-stack structures. The MLE nanostructures are based on redox capable NTCDI-layers, which are capable to sustain the macroscopic scale transport. The analysis of transport phenomena in molecular pi-stacks enables us to develop generalized charge transfer (GCT) model. GCT model proposes that consequence of multi-step structural and charge transfer (CT) processes yields efficient structure and electronic arrangement for fast and long range CT in organic solids. Each of consistent steps in GCT model is well-known in Natural Sciences; however GCT model imposed the certain dynamics of changes in electronic and structural environment to produce required net result. GCT model explains transport phenomena in π-stacks Molecular Nanoelectronic devices and propose way to achieve fast and long-range transport in organic materials. The other essential part of this research is an attempt to explain variety of contradicted transport measurements, which were conducted in DNA-based solid state devices. In this context, the goal of this paper is to formulate the common ground for Biologists and Molecular Nanotechnologest, which enables future progress towards study of fundamental questions related to DNA transport. We believe development of GCT model for π-stacks, will become this common ground for interdisciplinary studies toward insight of transport phenomena in organic and biological objects and insight how to organize fast and efficient charge transfer in molecular nano-electronics.