Electrical Conductivity Bistability in Nano-composite

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Abstract

The growth in the usage of organic materials in the fabrication of electronic devices owes to the ease of fabrication of organic electronic devices as well as the applicability of inexpensive substrates in such configurations [1]. Nano-composite polymer memory devices are fabricated by depositing a blend (an admixture of organic polymer, small organic molecules and nanoparticles) between two metal electrodes. These devices show two electrical conductance states ("1" and "0") when voltage is applied, thus rendering the structures suitable for data retention. These two states can be viewed as the realisation of non-volatile memory.

Nano-composite polymer memory devices comprising of a blend of a polymer and small molecules and/or nanoparticles are investigated [2, 3,4,5,6]. This study is aimed at further understanding the electrical bistability observed in such devices. This work also investigates if an electrical charge can be transferred to gold nano-particles and, between small molecule complexes. The electric force microscopy was used for charging the gold-nanoparticles. Current-Voltage (I-V) and Capacitance-Voltage (C-V) techniques were also employed in studying the charge transfer between small organic molecules (Donor-Acceptor pair). On the basis of this investigation our earlier model [5], based on electric dipoles formation in polymer matrix, is further scrutinised.

The progress in the nano-composite polymer memory devices over the last ten years will be presented, and invoke the conundrums that scholars of this field are currently faced with, such as questions about the electrical charging mechanism and stability of devices, proposed theories explaining the experimental data, contradictions in the published work by different groups. The proposed answers to the puzzles, wherever applicable, will be presented. The pre-requisites for the realisation of these memory devices will also be presented.

References

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