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Non-volatile Molecular Memory using Nano-interfaced Organic Molecules in the Organic Field Effect Transistor

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In our previous reports [1-3], electron transport for the switching and memory devices using alkyl thiol-tethered Ru-terpyridine complex compounds with metal-insulator-metal crossbar structure has been presented.

On the other hand, among organic memory devices, a memory based on the OFET is attractive because of its nondestructive readout and single transistor applications. Several attempts at nonvolatile organic memories involve electrets, which are chargeable dielectrics. However, these devices still do not sufficiently satisfy the criteria demanded in order to compete with other types of memory devices, and the electrets are generally limited to polymer materials. Until now, there is no report on nonvolatile organic electrets using nano-interfaced organic monomer layer as a dielectric material even though the use of organic monomer materials become important for the development of molecularly interfaced memory and logic elements. Furthermore, to increase a retention time for the nonvolatile organic memory device as well as to understand an intrinsic memory property, a molecular design of the organic materials is also getting important issue.

In this presentation, we report on the OFET memory device built on a silicon wafer and based on films of pentacene and a SiO2 gate insulator that are separated by organic molecules which act as a gate dielectric. We proposed push-pull organic molecules (PPOM) containing triarylamine asan electron donating group (EDG), thiophene as a spacer, and malononitrile as an electron withdrawing group (EWG). The PPOM were designed to control charge transport by differences of the dihedral angles induced by a steric hindrance effect of side chainswithin the molecules. Therefore, we expect that these PPOM with potential energy barrier can save the charges which are transported to the nano-interface between the semiconductor and organic molecules used as the dielectrics. Finally, we also expect that the charges can be contributed to the memory capacity of the memory OFET device.[4]

References

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