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Non-Volatile Organic Memory Device using Liq Molecules Inserted between Alq_3 Layers

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Recently, many organic conjugated materials have attracted a considerable interest due to their applications in field of the electronic and optoelectronic devices, such as an organic thin film transistors (TFTs), an organic light emitting diodes (OLEDs), and an organic solar cells. Besides those above mentioned, the interests about an organic memory having an electrical bistable switching property, in which a device exhibit two states (ON and OFF state) of different conductivities under the same applied voltage.

In this study, we report an electrical bistable switching property in two terminal organic memory cells fabricated with a sandwich structure of Alq_3/lithum quinolate (Liq)/Alq_3 and only Alq_3 between two external electrodes by thermal evaporation method under a high vacuum state about 5×10^{-6} Torr at room temperature. The conductance switching to two states such as ON/OFF states in the ITO/Alq_3/Liq/Alq_3/Al device shows their conductance difference by ON/OFF ratio of several orders (10^3) in magnitude and outstanding stability having a tendency to remain in that states for an extended period of times (~24h). Also, the high and low conductivity states of the memory cells can be exactly obtained by applying a negative voltage pulse to write or a positive voltage pulse to erase, respectively. The memory cells have been maintained during numerous (10^6) writing-erasing cycles in ambient conditions without serious degradation of the device performance, which was attributed to electron trapping-detrapping in the lowest unoccupied molecular orbital (LUMO) level of the Liq layer inserted between both Alq_3 layers by applied bias.

This kind of device will be an important role in future organic nanoelectronics. For high-density, light weight, flexible, and low-cost organic electronics, the development on the organic bistable memory is necessary.