Low Volatility Molecular Memory based on Dynamic Doping of Conducting Polymers

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A molecular electronic junction containing polypyrrole (~25 nm thick) and TiO_2 (10 nm) is formed by thin film deposition between two conducting contacts. The polymer is initially undoped, resulting in a high junction resistance of > 10KΩ. A positive bias pulse applied to the electrode adjacent to the polymer induces a large decrease in junction resistance, down to ~100 Ω. The transition from high to low resistance is reversible, repeatable at least 1600 times, and the two resistance states persist for > 7 days[1]. Switching speed is less than 10 µsec, which is competitive with today's commercial flash memory. Since the state of a memory "cell" is read out by conductance rather than charge storage, the polymer memory should scale to devices smaller than conventional DRAM. The mechanism of the conductance change was investigated by considering different polymers and metal oxides, and by probing working devices with Raman and UV-Vis spectroscopy[2,3]. The polymer is doped oxidatively under a positive "write" pulse, then undoped by a negative "erase" pulse. Thus "dynamic doping" by an applied bias is responsible for the observed conductance changes. Electron transport in polymer/TiO_2 devices and related molecular electronic junctions will be discussed[4-6].

References

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